# SCIENCE ABSTRACTS.

## Section A.—PHYSICS.

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**MAY 1925.**

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## GENERAL PHYSICS.

**987.** *The Theory of the Mechanical Analysis of Sediments by Means of the Automatic Balance.* **R. A. Fisher** and **S. Odén.** (Roy. Soc. Edinburgh, Proc. 44. 2. pp. 98–115, 1923–1924.)—Discusses the theory of the derivation of the distribution curve and the statistical methods appropriate for its deduction. The logarithm of the velocity of subsidence is used as the variate of the distribution; the result is a formula originally indicated by Odén, which shows that the characteristic distribution of the sediment may be obtained from the variation of density with depth, from the rate of change of density at a given depth, from the variation of hydrostatic pressure with depth, from the rate of change of hydrostatic pressure at a given depth. Schloesing's theory is shown to be incomplete. In practice the weight accumulated on a plate suspended in the liquid is automatically counterpoised, and a continuous record is taken of the progress of the weight with time. In this way it is possible to obtain values of the distribution function F throughout the period of measurement, where $F = v dP/dv$, and so $dP = F d(\log v)$; $v$ is the velocity of subsidence of any class of particles; P is the constitution of the sediment in respect of sedimentation, a function of $v$ representing the fraction by weight (in water) of the whole, which has a velocity of subsidence less than $v$. The statistical problems involved are discussed, and two duplicate experiments are considered. Consideration of the curves obtained indicates that large errors during the first 100 minutes of sedimentation are due to a vertical circulation, set up by initial disturbance when the fluid is poured into the measuring vessel. This may be remedied by increasing the viscosity of the liquid used. Convection currents become important in prolonged experiments where the finer particles are studied; they can be reduced by keeping the temperature as near as possible to that of the maximum density of water. H. N. A.

**988.** *Viscosity of Binary Mixtures.* **D. B. Macleod.** (Faraday Soc., Trans. 20. pp. 348–369, Dec., 1924.)—The general nature of the results of further work [see Abstracts 188, 189 (1924)] indicates that the "normal" curve for the viscosity of a liquid mixture is a sagged curve, the amount of sagging depending on the relative viscosities of the constituents. Mixtures which are formed with contraction tend to form maxima, the position and magnitude of these depending not only on the actual amount of contraction, but also on the viscosities of the components. Where the latter have viscosities of somewhat the same order and the contraction is considerable, a definite maximum appears, usually towards the greater viscosity. When the constituents have almost equal viscosities, the maximum occurs at almost equimolecular proportions. As the components become more and more different in viscosity, the maximum tends to disappear and the curve becomes S-shaped. The position of the maximum shifts with change of temperature owing to alteration in the viscosity of the constituents. Minima are usually accompanied by expansion on mixing, but it should be possible for dissociation alone to cause an actual minimum. The formation of compounds produces a loss of free space greater than that indicated by the change of density on mixing, so that the calculated viscosities are usually lower than the observed values. Such cases are easily explainable in terms of the author's hypothesis. Attention is directed to the futility of drawing inferences from the apparent shape of the viscosity curve of mixtures of two substances which contract or expand when mixed, without a knowledge of what the "normal" curve should be. T. H. P.

**989.** *Flow of Fluids in Pipe Bends.* **J. Eustice.** (Water and Water Engin. [11 pp.], July–Nov., 1924. Reprint.)—O. Reynolds' method of studying the flow of water, by introducing a tiny stream or filament of coloured water into the main stream in a glass tube, was used. When the stream passed into a bend the coloured filament was found to behave in a remarkable manner, being in some cases reflected from the wall on the outside of the curve, where it might divide into two separate filaments, and travel in a sinusoidal path across the tube towards the inner wall of the bend. With an elbow the filament could be reflected back almost parallel with itself, travelling in the up-stream direction for some distance, and then twisting round again to flow out round the inside angle of the bend. Such involved movements, of course, will set up vortices, which often continue in the succeeding straight pipe. The increased resistance in curved pipes is due to the difference in pressure between the outer and inner radius of the tube, caused by centrifugal force; this produces a hydraulic gradient from the outer walls of the curve to the inner ones, which causes the water to flow in this direction. Gauge readings were taken at a number of different points on the walls of different bends and elbows, and the loss of head determined for different radius of bend and diameter of tube. Curves are given showing the results. H. N. A.

**990.** *The Diffusion of Particles in a Suspension.* **J. H. Shaxby.** (Comptes Rendus, 180. pp. 195–197, Jan. 19, 1925.)—When a suspension is slightly acid the particles which diffuse to the walls of the containing glass vessel adhere to them, and the number which do so in a given time can be counted with the help of a microscope. L. Brillouin has used the method to determine Avogadro's number N, and the author has repeated the experiment, using an organism, staphylococcus, which grows in practically perfect spheres, the diameter of which is very uniform in the same culture. Brillouin used glycerine the viscosity of which made the effect of gravity on the particles he employed negligible; this liquid, however, destroyed the staphylococcus by osmosis, and it was necessary to use water. Two methods were possible; a deep vessel could be used, and the particles counted which were fixed on the wall at a depth such that at the end of the experiment they were in contact with the suspension, which fell with a uniform velocity; observations could be made at a smaller depth, when the suspension had completely settled. The number of particles will increase with the depth in this case, since the time during which a portion of the wall is in contact with the suspension is proportional to the depth. In a series of preliminary observations the second method was employed, and the value $59 \times 10^{22}$ obtained for Avogadro's number. It is intended to make further measurements, using the first method, which is probably more exact. H. N. A.

**991.** *Fractionating Column with Moving Parts.* **J. E. Myers** and **W. J. Jones.** (Chem. Soc., J. 127. pp. 4–8, Jan., 1925.)—The column described consists of a cylinder divided into sections by conical trays sloping slightly downwards towards the middle and having apertures at the apices. Through these apertures passes a revolvable shaft carrying a horizontal disc in each of the sections of the column. The discs catch the liquid falling from the sections above and distribute it throughout the different chambers. The results already obtained are promising, and indicate that the peripheral velocity of the discs is of importance rather than the exact shape of the discs or their speed of revolution. T. H. P.

**992.** *Spheroidal Wave-Functions.* **J. W. Nicholson.** (Roy. Soc., Proc. 107. pp. 43–60, Jan. 1, 1925.)—The solution of problems relating to vibrations in connection with spheroids—or, in two dimensions, elliptic cylinders—has hitherto only been attempted in one manner. Such discussions as have been given appear to have proceeded invariably along the lines of a determination of solutions in the form $\phi = f_1(\zeta)f_2(\mu)f_3(\omega)$, involving new types of normal functions $f_{1,n}(\zeta)$, $f_{2,n}(\mu)$, whose general term in an expansion in powers of $\zeta$ or $\mu$ cannot be expressed. These functions cannot, moreover, be expressed as definite integrals after the manner of Laplace's integral for the harmonic $P_n(\mu)$, and are thus suited only to the solution of physical problems by approximate methods. Attention is restricted in the present paper to a special case as an illustration of a general method of procedure in passing from a solution of Laplace's equation satisfying certain boundary conditions to a solution of the equation of wave-motion which satisfies the same conditions. A means of approach is thus found to a class of solutions of problems of oblate spheroids and discs not hitherto noticed, and the paper embodies a mathematical development of this type of analysis. For this purpose the solution is generalised of Laplace's equation which represents the motion of an oblate spheroid through a liquid along its axis of figure. It is pointed out that a certain analogy obtains with Parseval's method, which, by continued approximation, derives the solution of Laplace's equation in three dimensions from that in two. The analogy is derived from the fact that the equation of wave-motion is essentially that of Laplace with one more dimension. H. H. Ho.

**993.** *On Vortex Motion in a Resisting Medium with Application to Planetary Vortices.* **E. Belot.** (Comptes Rendus, 180. pp. 122–125, Jan. 12, 1925.)—The considerations on vortex motion advanced in this paper are based on the Magnus phenomenon, in which a body rotating in a resisting medium brings into play a lateral pressure component which causes deviation of the trajectory. The examples of planetary motion considered are Uranus, Neptune, and ultra-Neptune. H. H. Ho.

**994.** *On the Adherence of a Perfect Liquid to a Solid with which it is in Contact and the Theorem of Lagrange.* **M. Roy.** (Comptes Rendus, 180. pp. 117–119, Jan. 12, 1925.)—The condition of adherence of a perfect liquid (incompressible and inexpansible) to the wall of a contacting solid appears in general to be incompatible with Lagrange's theorem if the liquid is only subjected to external conservative forces and if the system considered is set in motion without abrupt variation of speed at any of its points. Boussinesq has shown for the case where the liquid is affected by viscosity that the condition of adherence to the wall is not in accord with the Lagrange theorem, and he has given an example in which the integrals of the relative motion are non-analytical functions of the time at the initial point. Duhem, from a study of the extension of Lagrange's theorem to viscous liquids, has shown the above condition to be necessary. The present mathematical paper shows from a consideration of the Boussinesq problem that when the perfect liquid is regarded as the limiting case of the viscous liquid the above difficulty may be removed.

H. H. Ho.

**995.** *Dynamical Illustration of Radiation Pressure.* **E. L. Nicolai.** (Phil. Mag. 49. pp. 171–177, Jan., 1925.)—Referring to a recent paper by T. H. Havelock [Abstract 2005 (1924)], the author points out that in the paper referrred to a particular solution of the problem of the vibrating spring is given for the case of a fixed and a moving node, the velocity of the moving node being constant. This particular solution corresponds to a normal vibration of the string in the limiting case of infinitesimal velocity of the moving node. The author has shown that the general solution can be obtained as made up of a series of particular solutions of the type indicated. This general solution was given by the author in a paper " On Transverse Vibrations of a Portion of a String of Uniformly Variable Length " [Ann. of the Petersburg Polytechnic Inst. 28. p. 273, 1921. In Russian]. The analysis is reproduced in the present paper. The pressure of the string on the plate is found from the equation of momentum applied to an element of the string, which slips through the hole in the moving plate during an infinitesimal interval of time.

G. W. DE T.

**996.** *Recent Developments in Tensile Testing.* **J. V. Howard** and **S. L. Smith.** (Roy. Soc., Proc. 107. pp. 113–125, Jan. 1, 1925.)

**997.** *Elastic Impact of Pianoforte Hammer.* **S. Bhargava** and **R. N. Ghosh.** (Phil. Mag. 49. pp. 121–129, Jan., 1925.)—The authors have previously shown that the elasticity of the hammer felt must be taken into consideration for calculating the duration of impact [see Abstract 2304 (1924)]. Kaufmann's approximate theory, with the additional consideration of the elasticity of the hammer felt, agrees fairly with the experimental results. In the present paper calculation is made of the transmission of energy to the string by the elastic hammer, and the effect of stiffness upon the duration of impact has been shown to diminish it, whatever the tension of the string. Finally, the law of pressure and the resulting amplitude of the partials have been calculated. It is found that Helmholtz's term plus two other terms are present, the latter not being negligible. The paper is mathematical throughout, and certain formulæ are proposed tentatively which it is hoped may be experimentally tested on a future occasion. E. H. B.

**998.** *Molecular Structure of Thin Films. Part VI.* **N. K. Adam** and **J. W. W. Dyer.** (Roy. Soc., Proc. 106. pp. 694–709, Dec. 1, 1924.)—Experimental methods as previously employed [see Abstract 185 (1924)] are applied to a further range of substances. Examination of a group of long-chain alcohols shows that the area of cross-section of the chain in the alcohols is the same as in the corresponding fatty acids, within 2½ %, the $CH_2OH$ group occupying 21·6 sq. Å.U. of area. The acetates of these alcohols pack with the heads occupying 23 sq. Å.U., and form expanded films of the same kind as other esters. The methyl ethers of the alcohols do not form stable films, the methyl group destroying the anchorage of the polar group on the water. Highly unsaturated acids, with three and five double bonds in the chains, behave very much like oleic acid, which has only one double bond. Arachidic acid and its derivatives behave normally. Eicosyl urea presents the same " allotropy " of packing, with a definite transition temperature, previously noted with chains having as end-groups $NH . CO . NH_2$ and $C_6H_4 . NH . CO . CH_3$. Substituted acetamides show a solid film with chains closely packed at low temperatures, and this melts at a definite temperature, raised by compression, to a liquid film of area 24·2 sq. Å.U. The probability is suggested that this melting is due to the molecules acquiring sufficient kinetic energy other than translational—that is, rotational about a vertical axis—or possibly vibrational, to break up the solid structure. Irregularities tending to mask the typical phenomena of condensed films are noted with hydrocarbons more than 27 carbons long. Penta-erythritol tetrapalmitate orients its four chains vertically in the surface, close packing not being complete until a compression of about 20 dynes/cm. is applied, this force being apparently necessary to strain the valency linkages from their normal direction. A. B. C. L.

**999.** *The Atomic Weights of Carbon and Silver.* **G. Dean.** (Chem. Soc., J. 125. pp. 2656–2672, Dec., 1924.)—When the author worked with silver cyanide in 1900 the atomic weights of silver and carbon had been considered established, whilst there were discrepancies between the physical and chemical determinations of the atomic weight of nitrogen then under investigation. The case is now reversed, and the atomic weight of carbon is questioned. The author applied three methods: (1) Silver cyanide was prepared, dried and reduced to metallic silver by heating to 300° in atmospheres of hydrogen and also of air and oxygen; the complete reduction to silver of constant weight took several weeks with about 9 gm. of silver. In one series of experiments (21 altogether) fractionation of the crystals was applied. (2) Silver cyanate was reduced simply by heating. Again three series altogether of 21 experiments were made. The average results of (1) $C = 12\cdot0024$ and (2) $C = 12\cdot0029$ depend upon $Ag = 107\cdot88$, $N = 14\cdot008$, $O = 16$. (3) Accepting these three atomic weights, the results could be checked by taking ratios, since $AgCNO$ (cyanate) $= AgCN$ (cyanide) $+ O$. The ratios $AgCN/Ag$ and $AgCNO/Ag$ gave $C = 12\cdot002$ and $C = 12\cdot003$ respectively. Combining these two ratios and assuming only $O = 16$, it would follow that $Ag = 107{\cdot}871$, and $(CN) = 26{\cdot}008$; and from this, with the assumption that $N = 14{\cdot}008$, the final value for C would be $12{\cdot}000$. H. B.

**1000.** *Duration of Life of Excited Atoms.* **W. Gerlach** and **W. Schütz.** (Phys. Zeits. 26. pp. 33–35, Jan. 1, 1925.)—From consideration of the fundamental conditions underlying the Wood-Ellet experiments with Na vapour, and known values of the wave-length and velocity of mean square, a higher limit has been obtained for the life of the excited atom. This is of the order of $10^{-7}$ secs. A lower limit is obtained from the Zeeman-effect by dealing with the change of the type of movement of the radiating electrons in the precessional movement. This limit lies between $10^{-8}$ and $10^{-9}$ secs., the magnitude depending upon whether the calculation is made with the radius of the normal or the excited atom. Confirmation of the figures is obtained by consideration of the rotation of the plane of polarisation in Na vapour in the neighbourhood of the D line for extremely small field strengths ($<0{\cdot}5$ gauss) and the destruction of the effect by the introduction of other gases (*e.g.* $H_2$ or $N_2$), the values of the times of penetration agreeing with those obtained from magnetised fluorescence. Similar calculations are made for Hg vapour. R. S. R.

**1001.** *The Magnitude of the Electrical Moments of Dipole Molecules and the Chemical Meaning of Orientation Polarisation.* **L. Ebert.** (Zeits. phys. Chem. 114. pp. 430–440, Jan. 20, 1925.)—Criticises a recent paper by C. P. Smyth [Abstract 287 (1925), which deduces from values of the electric moments calculated by him, and regarded as accurate to about 5 to 10 %, some detailed conclusions as to the arrangement of the electrons in a number of molecules. The author considers that the uncertainty of the values of $\mu$ are much greater than this, since it seems probable that the quantum theory should be used in calculating the molecular rotation instead of the classical theory, which may make a difference of 50 % in the calculated value of $\mu$. Smyth has not considered all the components of the polarisation, and neglects those designated by the author $P_A$ and $P_R$; it is shown that these may be of very considerable importance in organic compounds. The Gans formula used by Smyth has recently been criticised by Debye. Although in the present state of knowledge it is impossible to work out the fine structure from measurements of $\mu$, it is possible to gain some rough information, as in the case of the halogens, where $P_O(+P_A)$ diminishes in the series Cl, Br, I. This apparently shows how, in a series of related substances, with molecules of practically almost equal magnitude, the strength of self-association depends on the difference in the values of $\mu$. Several other compounds are considered. H. N. A.

**1002.** *Atomic Rays Nomenclature.* **W. Gerlach.** (Ann. d. Physik, 76. 1. pp. 106–108, Jan., 1925.)—Proposes to reserve the name *Atomstrahlen* (atomic rays) to the case of atoms passing through one or a series of openings into a space B, evacuated so that the free path of the contained molecules is very large compared with the dimensions of the space. The stream of atoms, which may be made quite narrow, travels in straight lines to the walls of B, where the atoms are deposited; they pass through the opening at such intervals that, in spite of the fact that their velocities are distributed according to Maxwell's law, there are no collisions, and the atoms are not electrified [see Abstract 2663 (1924)]. C. G. Schmidt has recently used the term *Atomstrahlen* for a different phenomenon, where ions are sent out from heated salts; the author proposes that these moving ions should be called *Ionenstrahlen*, the first term being reserved for the atomic streams described above. H. N. A.

**1003.** *On the Atomic Fields of Helium and Neon.* **J. E. Jones.** (Roy. Soc., Proc. 107. pp. 157–170, Jan. 1, 1925.)—The methods of previous papers [Abstracts 288 and 289 (1925)] are used, with certain modifications. In the case of helium the atomic field has been determined by using the experimental results on its viscosity and its equation of state. The two results obtained agree closely, and lead to a field represented by a repulsive force $\lambda_n r^{-n}$ with $n = 14$ and $\lambda_n = 5\cdot74 \times 10^{-113}$, and an attractive force $\lambda_m r^{-m}$ with $m = 5$ and $\lambda_m = 1\cdot930 \times 10^{-45}$. In the case of neon, experiments have been made by Crommelin, Martinez and K. Onnes on the equation of state, but the results are such that it is not possible to use them in this investigation. Measurements of viscosity are also meagre, but it is possible to deduce values for the viscosity from several measurements of thermal conductivity made by Weber. Measurements of the interatomic distances of the crystals NaF and MgO are used in deciding between the different models which explain the facts. The final result is that $n = 21$ and $\lambda_n = 3\cdot892 \times 10^{-165}$; the attractive force is not determined, but is shown to be weak. H. N. A.

**1004.** *Electron Tables.* **G. Fournier.** (J. de Physique et le Radium, 6. pp. 29–32, Jan., 1925.)—Contains tables for values of $\beta$ (the ratio of the velocity of the electron to that of light) ranging from 0·01 to 0·9995, giving the values of $\sqrt{1-\beta^2}$, $1/\sqrt{1-\beta^2}$, $\beta/\sqrt{1-\beta^2}$, the kinetic energy $\omega$ in ergs, the emission voltage and the product H$\rho$ in gauss cm. of the radius $\rho$ of the circular path of the electron, and H the magnetic field.
H. N. A.

**1005.** *Isotopes of Lead.* **H. Brennen.** (Comptes Rendus, 180. pp. 282–283, Jan. 26, 1925.)—Brief reference is made to various efforts by other investigators to separate the isotopes of lead. An attempt is now made by a chemical method, using Grignard's reaction on chloride of lead:
$HC_2H_5MgI + 2PbCl_2 = Pb + Pb(C_2H_5)^4 + 4MgICl$.

The results are summarised :—

| | Atomic Weight. | |
|---|---|---|
| Series I (using ordinary lead) | (a) 207·15 | (a) before treatment. |
| | (b) 207·155 | (b) after preparing by Grignard's reaction. |
| Series II (using a mixture of equal quantities of ordinary lead and radio-active lead (about 206·55)) | (a) 206·87 | |
| | (b) 206·88 | |

As the atomic weight of lead in the determination (a) and (b) is the same within experimental error limits, it is concluded that it is not possible to separate isotopes of lead by Grignard's reaction. A. B. W.

**1006.** *Molecular Orientation of Fatty Acids.* **J. J. Trillat.** (Comptes Rendus, 180. pp. 280–281, Jan. 26, 1925.)—Certain substances, such as the fatty acids, are capable of orientating their molecules when deposited on a surface of glass, assuming a "smectic" structure. [See Friedel, Abstract 985 (1923).] The molecules arrange themselves parallel to one another, their extremities forming equidistant planes parallel to the surface of the glass. Such an arrangement gives good X-ray reflections by the rotating crystal method. In the present work the author has determined, by means of X-rays, the structure of this periodic arrangement and the manner in which the orientation of the molecules varies with the thickness of the layer. Both methods, transmission and reflection, have been employed, and a comparison has yielded interesting information regarding the internal structure. The substance studied was palmitic acid. A. B. W.

**1007.** *Theory of the Flowing Ether.* **O. Wiener.** (Phys. Zeits. 26. pp. 76–81, Jan. 1, 1925.)—Mathematical discussion. E. H. B.

**1008.** *Quantum Theory and Some Periodicity Characteristics of Mechanical Systems.* **G. Wataghin.** (Ann. d. Physik, 76. 1. pp. 41–48, Jan., 1925.)—Ehrenfest has suggested that in a mechanical system having $n$ degrees of freedom such that the canonical variables $q_1 \ldots q_n, p_1 \ldots p_n$, can be expanded in $u$-fold Fourier series, if the system in the course of its motion passes through every point of the $\rho$ dimensional domain of $q, p$ space, then $u = \rho$. This hypothesis is analysed, and it is shown that although in general the case $u > n$ (and even $u > 2n$) may occur, this condition is specially excluded in the case of the stationary conditions of the atoms, as then the forces would not be derivable from a potential and there would be no energy integral. [See Abstract No. 763 (1924).] J. S. G. T.

**1009.** *Lines of Force in the Special Theory of Relativity.* **G. Jäger.** (Akad. Wiss. Wien, Ber. 133. 2a. No. 1–2. pp. 43–46, 1924.)—The components of a mechanical force referred to axes $x$, $y$ and $z$ in a system S at rest are X, Y and Z. Assuming that in a system S′ which is in uniform motion with a velocity $v$ parallel to the common direction of the $x$ axis in the two systems, the lines of force still represent the direction of the force and that the density of the lines represents the magnitude of the force, it is shown that components of the force related to axes in the system S′ are given by $X' = X$, $Y' = \beta Y$ and $Z' = \beta Z$, where $\beta = (1 - v^2/c^2)^{-\frac{1}{2}}$. The corresponding transformations for the electric components $\xi, \eta, \zeta$ and the magnetic components $\lambda, \mu, \nu$ of an electromagnetic force are shown by the application of the same principle to be $\xi' = \xi$; $\eta' = \beta(\eta - v\nu/c)$; $\zeta' = \beta(\zeta + v\mu/c)$; $\lambda' = \lambda$; $\mu' = \beta(\mu + v\zeta/c)$; $\nu' = \beta(\nu - v\eta/c)$.
J. S. G. T.

**1010.** *Riemannien Projective Nature of the Gravitational Electromagnetic Field.* **H. Eyraud.** (Comptes Rendus, 180. pp. 127–129, Jan. 12, 1925.)—This paper consists of a systematic identification of physical quantities and geometric tensors, the result of which, the author claims, is to demonstrate the truth of J. A. Schouten's hypotheses [Abstract 1690 (1924)], according to which the electromagnetic field is to be regarded as a combined twist and spin of the four-dimensional space-time. G. W. DE T.

**1011.** *F. Schenner's Comparison of Jaumann's Theory of Gravitation with Observations.* **E. Lohr.** (Akad. Wiss. Wien, Ber. 133. 2a. No. 1–2. pp. 35–41, 1924.)—Schenner's deduction of a disagreement between results based upon Jaumann's theory of gravitational and results of observation is shown to be invalid. [See Abstract 1320 (1912).] J. S. G. T.

## METEOROLOGY AND GEO-PHYSICS.

**1012.** *The Breathing of the Atmosphere.* **O. Myrbach.** (Meteorolog. Zeits. 42. pp. 10–14, Jan., 1925. Paper read before the Deut. Naturforscher u. Ärzte, Innsbruck, 1924.)—The study of weather conditions in Vienna led to the following hypothesis: The transition from the winter distribution of pressure (high over the continents, low over the seas) to the reverse conditions prevailing in summer is not uniform, but rhythmical. The continents are like lungs, breathing rhythmically, the period of the oscillations being conditioned by the extent of the continents and of their compensation areas. The compensation areas of the two great continents are the two great oceans and the Polar basin, on which latter the action of the surrounding continents is concentrated. The centre of the continental actions is not at the Pole, but in the region of the North Cape. This explains the position and extreme importance of the so-called Iceland minimum. The meteorological North Pole is to be sought between Iceland and the North Cape. The paper is illustrated with tables and curves. E. F.

**1013.** *Methods for Measuring Humidity.* **S. P. Ferguson.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 119–121, Jan., 1925.)—A summary is given of the following methods employed to measure or determine humidity: (1) Chemical or " absolute " method, (2) condensation or dew-point method, (3) psychrometric method (wet-and-dry-bulb thermometers), and (4) change in volume of hygroscopic materials (the hair hygrometer). The probable percentage error with each method is discussed. R. S. R.

**1014.** *Rain observed during Anticyclones.* **E. G. Mariolopoulos.** (Comptes Rendus, 180. pp. 82–83, Jan. 5, 1925.)—Slight rain has been observed most frequently on or near the coast under these conditions. Two causes are given: (1) Cooling experienced in winter when a breeze blows from the sea over relatively cooler land surfaces, and (2) mixing of two air currents at different temperatures. The latter is indicated on weather charts by discontinuities of wind direction and of temperature at or near where rain is falling. The discontinuities may often be more marked in the upper air than at the ground. A good example of this process is discussed. R. S. R.

**1015.** *Orographic Precipitation.* **S. Ono.** (Phil. Mag. 49. pp. 144–164, Jan., 1925.)—This paper contains a mathematical discussion of the distribution of orographic precipitation deduced from the air motion, assuming the motion to be steady and continuous and everywhere parallel to a definite vertical plane. The motion is considered under the following conditions: (1) Constant density, (2) isothermal, (3) adiabatic equilibrium, (4) pseudoadiabatic equilibrium. The method is applied to the calculation of the precipitation in the Yamagata province during the passage of a cyclone on the 20th and 21st Jan., 1921, and the resulting distribution shows good agreement with the orographic part of the snowfalls recorded. It is concluded that the snowy climate of northern Japan is due chiefly to orographic precipitation. A. W. L.

**1016.** *Diagnostic and Prognostic Application of Mountain Observations.* **J. Bjerknes.** (Geofysiske Publ. 3. 6. [35 pp.], 1924.)—The records considered are for Alpine observatories for the period Jan. 21 to Feb. 2, 1913, during the passage of a trough of low pressure with a complex occluded front, followed by a newly developing cyclone which moved from the Bay of Biscay across the Alps to Russia. The temperature registrations show the typical differences of structure between growing and old cyclones. Particular attention is directed to the warm front surface of the newly formed cyclone, which is found to be a layer of transition, about 160 m. thick, sloping at roughly 1/200 in a direction S.75° W. It is pointed out that the warm front is more usually associated with a subnormal lapse-rate than with a real inversion of temperature. One "surface of subsidence" is identified, which has an inclination of about 1/1000, and joins the steeper warm front surface at a level of about 2000 m. The lines of flow are determined, and show that the cold air slides rapidly downwards and backwards relatively to the moving system, and the warm air upwards and forwards. Comparatively high temperature is maintained in advance of the warm front by the subsidence of Polar air, but in the foremost part of the warm sector temperature is low, owing to the cooling brought about by mixing at the ground and by contact with precipitation. The equations characterising the motion in the neighbourhood of the warm front are obtained from those for a true surface of discontinuity. Several of the results are generalised to show the accelerations: (1) Due to upward and downward sliding of air masses, (2) in a system composed of a warm front surface and a surface of subsidence, (3) and (4) favourable and not favourable for the formation of a **V**-shaped depression. A. W. L.

**1017.** *Graphical Relations based on recently discovered Physical Qualities.* **E. Kreitmeyer.** (Meteorolog. Zeits. 41. pp. 380–388, Dec., 1924.)—Many graphical methods employed in representing physical quantities need revision in the light of recent research, the author instancing a number of these. Equations are established in a number of cases, and the relations obtained exhibited graphically for (1) the variation of the mass of water-vapour in grammes per kilo. of saturated air at different temperatures and pressures; (2) the absolute humidity expressed in grammes of water-vapour per cubic metre of air for different temperatures and pressures; (3) the relation between relative humidity, dew-point and temperature; (4) reduction of pressure readings to mean sea-level for stations at high altitudes; and (5) the decrease of temperature, adiabatically, with height for dry air and saturated air, and for the conditions when hail occurs.

R. S. R.

**1018.** *Turbulence and Vertical Temperature Difference near Trees.* **L. F. Richardson.** (Phil. Mag. 49. pp. 81–90, Jan., 1925. Paper read before the British Assoc., Toronto, 1924.)—Thermojunctions, shielded from rain and direct radiation, were employed to measure the air temperature at heights of 4·4 and 18·3 metres above the ground. Statically unstable vertical temperature gradients were frequent between 10 h. and 16 h. G.M.T. At such times confirmation was obtained by the air rising in streaks and patches. The gustiness of the air is small when the air is much colder below, but increases, as the layer becomes less stable. After exceeding the normal adiabatic lapse rate gustiness did not increase, although the layer was then definitely unstable. The theory of the supply of energy to or from atmospheric eddies [Abstract 1973 (1921)] is restated and an expression obtained for "just-no-turbulence" which agrees roughly with observed facts, in spite of friction between the trees and the moving air. Isopleths of the range of gusts are given for the region far from the condition of "just-no-turbulence." R. S. R.

**1019.** *The Origin of Wind.* **V. Korotkewitsch.** (Meteorolog. Zeits. 42. pp. 15–18, Jan., 1925.)—From the general hydrodynamical equations and the equations of heat supply and of continuity expressions are obtained for the components of the motion of the air along three directions at right angles, and it is shown that these movements are essentially dependent upon the nature of the heat supply. If the heat supply is uniform, no motion of the air results. It is shown that with irregularities in the heat supply an irregular pressure distribution results. The pressure change will produce one of two changes: (1) For a heat supply irregular with height, vertical movement of the air precedes the horizontal movement; (2) for an irregular flow of heat horizontally, vertical air movements come later than the horizontal ones. From the formulæ obtained the direction of the horizontal movement is also determined. R. S. R.

**1020.** *Note on the Bodily Tide on a Fluid Earth.* **H. Jeffreys.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 157–160, Dec., 1924.)

A. W. L.

**1021.** *Possible Air Movements at the Earth's Surface.* **T. Hesselberg.** (Geofysiske Publ. 3. 7. [22 pp.], 1924.)—Spatial air movements which are physically possible, are difficult to work out, since in addition to the equations of motion, the continuity and state equations together with the conditions of the mechanical theory of heat must be satisfied. The present paper deals with seven selected problems in order to avoid the most severe mathematical difficulties of the general case. From the considerations advanced, the author opines it more advantageous to find fields of motion which satisfy the third vortex equation prior to a determination of the pressure field. By this procedure integrals of the equations of motion can be found in many cases where difficulties arise by ordinary methods. Sources of error are pointed out for treatment later. H. H. Ho.

**1022.** *Metric Verification of the Ovoid Shape of the Earth.* **C. Gorceix.** (Comptes Rendus, 180. pp. 152–154, Jan. 12, 1925.)—By a study of the arcs measured in Central Europe and Africa it is concluded that the geodetic measurements and actual calculations agree best with an ovoid shape for the earth, with dimensions between those given by Clarke and Bessel for their ellipsoids. The flattening occurs in the northern and the tapering in the southern hemisphere. To a first approximation one can employ two ellipsoids, one for each hemisphere, but with different semi-axes towards the Poles. R. S. R.

**1023.** *The Depth of Earthquake Focus.* **S. K. Banerji.** (Phil. Mag. 49. pp. 65–80, Jan., 1925.)—The conclusions reached by Walker on the depth of earthquake focus [Abstract 1976 (1921)] are investigated. Following the method employed by Lamb for the propagation of tremors in a semi-elastic solid, a general expression is obtained for the displacement at any point of the earth's surface from a disturbance at a depth *f*, assuming a definite type of source and no stress on the boundary. Substituting particular values for $f$, it becomes evident that the amplitude of the Rayleigh waves decreases very rapidly with increasing depth of focus. For large epicentral distances the depth of focus has little effect on the amplitude of the longitudinal and transverse waves. By substitution in the general expression for definite values of $f$ it becomes evident that waves on seismograms cannot be obtained for focal depths greater than 100 km. If the earth be assumed spherical, the effect of focal depth on the amplitude of the Rayleigh waves becomes more accentuated, and a depth of even 100 km. seems too great. Experimental evidence in support of a high or deep focus is so far inconclusive. R. S. R.

## ASTRO-PHYSICS.

**1024.** *Corrections to Hourly Signals, Emitted, Registered, or Observed by B.I.H.* **G. Bigourdan.** (Bull. Astronomique, 4. 2. pp. 147–274, 1924.)—The 1923 signals, all radiotelegraphic, are of the same types as those of 1920–1922. The International Astronomical Union at Rome in May 1922 expressed a wish that the zero points should be indicated by a *dash*, instead of a *point* which might pass unnoticed, and this was put in practice from October 15, 1923. Tables are given of the signals; of corrections to the director and time-keeping pendulums, and of the semi-automatic signals; also of the normal rhythm signals and of the comparative times of receiving them by different observatories. A. S. D. M.

**1025.** *Cosmogony of Systems of Decreasing Mass.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 85. pp. 2–11, Nov., 1924.)—Several problems are discussed in the light of Eddington's theory that the radiation from a star is at the expense of its mass. Russell has shown that the undisturbed orbits of the binary stars can only increase in size to a limited extent. The orbits of binaries of decreasing mass are investigated and are shown to be increasing ellipses of constant eccentricity. Hence the observed high eccentricity of many binary orbits is not accounted for directly. The new theory leads, however, to a very extended time scale and it is pointed out that this suffices to explain these high eccentricities as due to encounters with passing stars. This extended time scale also shows that the tidal birth of satellites will be more likely than has hitherto been assumed but will still be a rare occurrence. Finally the theory is applied to the orbits of particles in spiral nebulæ. In general the orbits will be spirals and, for stars of very great mass, should depart appreciably from circles. In the case of the Andromeda nebula it is doubtful if the orbits can depart far from circles. A. Wh.

**1026.** *Distance and Linear Dimensions of the Large Magellanic Cloud.* **H. Shapley.** (Harvard Coll. Obs., Circ. 268. [4 pp.], 1924.)—The parallax of the large cloud, based on the luminosity-period curve of 21 variable stars and the apparent angular diameters of six globular clusters contained in it, corresponds with a distance of 34·5 kiloparsecs, or 112,000 light-years, and the distance separating the two clouds is 12 kiloparsecs. The large cloud is nearly circular in outline, with a linear diameter (projected) of 4·3 kiloparsecs. The looped nebula, 30 Doradus, contained in it, is probably by far the largest luminous gaseous nebula known. M. A. E.

**1027.** *Stellar Spectrophotometry.* **J. Baillaud.** (Bull. Astronomique, 4. 3. pp. 275–349, 1924).—The author has attempted to determine the distribution of energy in the spectra of stars of types B, A, and F, under the most rigorous conditions. Observations were made at an altitude of 2860 m., where atmospheric absorption is particularly small and regular. The stellar radiation was analysed by a camera with prisms of spar and quartz and compared directly with radiation from an incandescent lamp by a scale of densities, the two spectra being photographed simultaneously with the same exposure. The lamp had been compared with the positive crater of an arc serving as a black body. In two cases the curve of spectral energy is traced from λ3300 to λ6500, and for the other stars from λ3300 to λ4750. The curve for α Canis Minoris approximates to that of a black body at 7000°, having maximum intensity about λ4200. The curves for other stars are entirely different from the black body type. The author considers the continuous spectrum of A and B type stars to be not due to temperature emission but to radiation of ionised atoms analogous to that observed in hydrogen, and in metallic vapours in vacuum arcs by Procopiu. It is observed as an emission spectrum in stars of type B, and in type A as partly emission and partly absorption in a similar manner to different members of the Balmer series in the case of certain brilliant stars. *Atmospheric absorption.*—The coefficients of transmission of various radiations between λ3500 and λ6500 A have been studied at the Pic du Midi in 1920 and 1921. In normal conditions the curve is similar to that obtained by Abbot at Mount Wilson. Considerable absorption of rays shorter than λ3800 A was observed on one particularly humid night, which suggests an extended band due to water-vapours and terminating near that point. The author has not observed the phenomenon of reversal of relative intensity of absorption from red to violet between the day and night which has been given as the rule by Nordmann for Paris and Switzerland.
F. S.

**1028.** *Third Catalogue of Spectroscopic Binary Stars.* **J. H. Moore.** (Lick Observat., Bull. No. 355. pp. 141–185, 1924.)—Since the year 1910, when Campbell published the Second Catalogue of these stars, the number known has increased from 306 to 1054, and the number of well-determined orbits from 71 to 248. The present Catalogue includes all stars whose variable radial velocity had been announced prior to July 1, 1924, and all the principal facts available concerning these systems. It will be found convenient to have all these in one list, although recent research shows that variable radial motion may not always be evidence of a binary system, especially in the case of Cepheid variables, where it may indicate pulsations of a single star. Magnitude and spectral class, discoverer and references are given for each of the 1054 stars.
M. A. E.

**1029.** *Orbit of the Spectroscopic Binary* 66 *Eridani.* **E. B. Frost** and **O. Struve.** (Astrophys. J. 60. pp. 313–323, Dec., 1924.)—The orbit of this spectroscopic binary is based upon measurements of eighty-three spectrograms. The velocities are determined for each component, which have a maximum relative velocity of 220 km./secs. Each component is of spectral type B9. The period is $5^d \cdot 52242$. The preliminary elements were slightly improved by a least-squares solution. The K lines of calcium are sharp in each component and yield the same radial velocities as do the other lines. It is evident that there can be no stationary K component, as this should be easily visible at maximum separation of the oscillating K lines. AUTHORS.

**1030.** *Spectra of Class O Stars.* **Cecilia H. Payne.** (Harvard Coll. Obs., Circ. 263. [16 pp.], 1924.)—Existing classifications of these stars are shown to be unsatisfactory, and an attempt is here made to arrange 38 Harvard O-type spectra in a temperature sequence on the basis of absorption lines only. The Wolf-Rayet stars are subjected to the same criterion as the others, since nearly all are found to have absorption lines as well as their characteristic emission lines, and emission may occur at any point in the sequence. The immediate adoption of any classification similar to that used for the cooler types is considered inadvisable, especially as O stars are few in number and their spectra are difficult to measure. M. A. E.

**1031.** *Fifty-nine New Variable Stars.* **Annie J. Cannon.** (Harvard Coll. Obs., Circ. 265. [4 pp.] 1924.)—In studying photographs of some Milky Way clouds in Sagittarius and Scutum, 59 new variables have been discovered, which are here tabulated. They are provisionally classified as follows: 18 Cepheids, 10 eclipsing, 26 long-period, 5 of unknown class. M. A. E.

**1032.** *Scattering and Absorption in the Atmospheres of Emission-Line Stars.* **M. C. Johnson.** (Roy. Astron. Soc., M.N. 85. pp. 56–70, Nov., 1924.)—The recent sources of evidence as to scattering and absorption mechanisms are critically examined to find the limit within which may vary the values of different kinds of opacity coefficient for application to Schuster's theory of emission-line spectra. It is found that with the resulting mass coefficients the ratio $S/\kappa$ can never reach the value needed by Schuster's criterion. The validity of this emission-line theory is therefore sought instead in some gravitational and radio-active peculiarities of the atmospheres of these stars; and a condition of transition between one kind of opacity and another is suggested, which in the sun is confined to a narrow zone, but in bright line stars is wide enough to allow a large effective scattering, even with a small coefficient. The reasons for the existence of this transition zone are worked out from recent data of mass, luminosity, density temperature, and the possible place in the theory of the anomalous P and Me spectra is discussed. [See also Abstract 997 (1905).] A. W. J.

**1033.** *Luminosities and Parallaxes of* 525 *Stars, Types Fo to Mb.* **W. B. Rimmer.** (Roy. Astron. Soc., Mem. 64. pp. 1–25, 1925.)—Of the 525 stars, no spectroscopic determinations have been published for 237, and for 206 no previous determinations at all. All the spectra have been classified according to some well-graded standard. Special pairs of lines have been measured to obtain the curves relating difference of intensity to absolute magnitude for the most luminous F and G stars, from a comparison of the spectrum of $\gamma$ Cygni (a pseudo-Cepheid of abs. mag. $-3\cdot0$) and of $\alpha$ Aurigæ (a giant of abs. mag. $-0\cdot6$); and similarly for very luminous M stars, from $\mu$ Geminorum (abs. mag. $-0\cdot8$) and $\alpha$ Scorpii (abs. mag. $-3\cdot3$). The basis of results is given: For earlier F types from Schlesinger's "cluster" parallaxes; for the pseudo-Cepheids from parallactic motions alone; for the later K and M types from trigonometric parallaxes; and for the very luminous stars from a combination of trigonometric parallaxes and proper motion data. A comparison of results is given with: (*a*) Victoria for M and K types; (*b*) Mt. Wilson for about 200 stars; (*c*) Harvard for 47 stars; (*d*) trigonometric parallaxes for 127 stars; and (*f*) some difficult F type stars are divided into three groups, each group sharing some peculiarity. The catalogue itself occupies rather more than fourteen pages. [See Abstract 1812 (1923).] A. S. D. M.

**1034.** *Equilibrium of Calcium Chromosphere.* **E. A. Milne.** (Roy. Astron. Soc., M.N. 85. pp. 111–141, Dec., 1924.)—The problem solved is that of equilibrium under radiation pressure of an atmosphere whose atoms possess only two stationary states, the "normal" and the "excited." [See Abstract 1726 (1924).] Each atom alternately absorbs and emits quanta of amount $h\nu$, thereby acquiring momentum and recoil momentum of amount $h\nu/c$, where $c$ is the velocity of light. The pressure of radiation arises solely from the absorption of quanta $h\nu$. The author describes the mechanism of the formation of an absorption line. For an atmosphere in a steady state he finds the ratio of the force arising from radiation pressure to that from gravity to be $\alpha\pi F_\nu\Delta\nu/mgc \times n_1/(n_1 + n_2)$, where $\alpha$ is the atomic absorption coefficient for an atom in the "normal" state, and $n_1$ and $n_2$ are the numbers of atoms per unit volume in the "normal" and "excited" states respectively. The character of the states of equilibrium depends on $F_\nu$, which is the residual intensity in the absorption line. In one limiting case the whole of the weight of the atom at great heights is "fully supported by radiation pressure." Where this does not hold good at great heights the atmosphere is said to be "partially supported by radiation pressure." The distribution of density ($\rho$) is entirely different in the two cases. At a height $x$ for the "fully supported" $\rho = (\text{const.})/(x + x_0)^2$, where $x_0$ is the height of the equivalent homogeneous atmosphere. This is 3600 km. in the sun for $Ca^+$ atoms, and $\rho$ decreases to 1/23 of its value at a height of 14,000 km. For the "partially supported" calcium atmosphere $\rho$ is distributed as in a gravitating atmosphere where $g$ is reduced, and for a partial support of 99%, $\rho$ decreases by $10^{-8}$, of 90%, by $10^{-80}$ in 14,000 km. It is concluded that the high-leve solar calcium chromosphere is "fully supported," as its observed extent is incompatible with any theoretical exponential density law. The "partially supported" atmosphere is so condensed at its base as to be indistinguishable from the reversing layer; and if any departure from an exact balance of pressure at great heights occur, the whole atmosphere will collapse on the reversing layer. The author applies his results to Jeans' theory of planetary nebulæ [see Abstract 798 (1924)], and shows this to be impossible, whether the planetary envelope is at rest or rotating. A. S. D. M.

**1035.** *Relation of Mean Parallax to Proper Motion and Apparent Magnitude.* **Gorakh Prasad.** (Roy. Astron. Soc., M.N. 85. pp. 157–178, Dec., 1924.)—This investigation was undertaken in order to obtain improved values of the constants represented in Luyten's formula [see Abstract 2121 (1923)] by using trigonometrical parallaxes of a much larger number of stars than his, and treating them by an improved method. The relation between H ($= 5 + m + 5 \log \mu$) and mean absolute magnitude is determined for each spectral type separately, and it is found to be linear except for the F and G stars. In K and M stars giants and dwarfs had to be considered separately. Comparison is made with the mean parallaxes of van Rhijn (Groningen Publications, 34, 1923). M. A. E.

**1036.** *Occultation of the Star B.D. −18° 6078 by Mars.* **S. D. Tscherny.** (Roy. Astron. Soc., M.N. 85. pp. 191–194, Dec., 1924.)—This was observed at Kiew Observatory on 1924, September 5. The parallax of Mars was deduced from micrometrical measurements of the position-angle and distance of the star from the centre of Mars before and after disappearance, and the resulting corrections to Newcomb's Tables, as given in the Nautical Almanac, are $\Delta\alpha = +0''\cdot017$; $\Delta\delta = -1''\cdot87$. The polar diameter of Mars, measured between disappearance and reappearance, gives, for 10h. 4m. G.M.T., $25''\cdot940$, and the difference between this value and the value calculated from the Nautical Almanac is $+1''\cdot76$. From the observations, the coordinates of Mars (N.A.), and the horizontal parallax (N.A.), the deduced equations of condition give $\Delta\alpha = +0''\cdot064$; $\Delta\delta = -3''\cdot057$ for Newcomb's Tables. M. A. E.

**1037.** *Solar Constant and Solar Activity.* **I. Yamamoto.** (Roy. Astron. Soc., M.N. 85. pp. 71–78, Nov., 1924.)—An attempt is made to correlate the solar constant and the area of the calcium flocculi. Mount Wilson spectro-heliograms are examined and the area of the calcium flocculi determined on an arbitrary scale. The solar constant appears to be quite independent of the calcium activity except that there is an abrupt drop about the time of minimum calcium and sunspot activity. This is at present unexplained. A. Wh.

**1038.** *Proper Motions in Latitude of Sunspots and Faculæ.* **Royal Observatory, Greenwich.** (Roy. Astron. Soc., M.N. 85. pp. 185–191, Dec., 1924.)—The latitudes of sunspots which have reappeared at successive solar rotations are examined over a period of fifty years, 1874–1923, in order to confirm or disprove Carrington's suspicion of a poleward tendency for high-latitude spots. The results show that no such tendency exists. Faculæ, however, show distinctly a poleward drift, which is more pronounced in high than in low latitudes, reaching nearly 1⅓° per sidereal rotation in latitudes 20° to 30°. M. A. E.

**1039.** *Observations of Masses of Absorbing Vapour at Great Heights above the Solar Surface.* **L. d'Azambuja.** (Comptes Rendus, 180. pp. 47–49, Jan. 5, 1925.)—Deslandres and his collaborators have noted the local doubling on the violet side of the central dark component of the K line of calcium in regions where little evidence of a violent disturbance is given by the spectroheliograph. There are indications that this phenomenon is not uncommon, and the evolution of two disturbances is noted. There appears to be a close connection between these phenomena and protuberances, and some investigators definitely identify the two. A. Wh.

**1040.** *Measurement of the Intensity of the Light of the Corona at the Eclipse of September* 21, 1922. **G. H. Briggs.** (Astrophys. J. 60. pp. 273–281, Dec., 1924.)—Measurements of the total intensity were made at Goondiwindi, Queensland, with two photoelectric cells by a method similar to that used by Kunz and Stebbins [Abstract 853 (1919)]. With each cell it was found that there was a maximum at the beginning and at the end of totality. The results obtained with cell 1 showed changes in intensity, in Hefner candle-meters, from 0·37 for the first reading to 0·23 at mid-totality and to 0·29 just before the end of totality. With cell 2 the corresponding results were 0·34, 0·22, and 0·27. Reduced to no atmosphere, these become 1·02, 0·64, and 0·81 for cell 1, and 0·95, 0·61, and 0·72 for cell 2. In Table III the results of a comparison of the corona and the full moon are given. In support of the reality of the variations observed, reproductions of prints made from negatives obtained at Goondiwindi by J. Nangle are given. These show that very bright portions of the corona which were visible near second and third contacts were covered by the moon during mid-totality.

AUTHOR.

**1041.** *Recent Work on the Luminosity Curve.* **W. J. Luyten.** (Harvard Coll. Obs., Circ. 262. [7 pp.], 1924.)—The writer discusses the work of Seares on this problem [Abstracts 1734 and 2702 (1924)] and of Malmquist (Lunds Obs. Medd. II. 32, 1924). Their results differ from his own, and he believes that the observational material is not adequate to permit calculation of a new luminosity law with any precision. At present it would be best to use Kapteyn's form unmodified, because it is analytically the simplest. M. A. E.

**1042.** *Photographic Measures of Earthlight.* **E. S. King.** (Harvard Coll. Obs., Circ. 267. [11 pp.], 1924.)—The brightness of that part of the moon illuminated by earthlight, calculated by comparing photographs of the moon with out-of-focus photographs of stars, is provisionally determined as −1·60 photographic magnitude. A study of the effect of sky illumination on the visibility of the moon in daylight has also been made. Methods are fully described, and some of the photographs are reproduced.

M. A. E.

**1043.** *Preliminary Elements and Ephemeris of Object Baade.* **A. O. Leuschner.** (Lick Observat. Bull. 11. No. 357. pp. 187–189, 1924.)—A full account is given of the computation of the orbit of this minor planet. It is the fourth in order of closest possible approach to earth in opposition at perihelion, and its orbit has an unusually high eccentricity and inclination. M. A. E.

**1044.** *Polarisation of Light from Saturn and its Rings.* **B. Lyot.** (Comptes Rendus, 179. pp. 960–963, Nov. 10, 1924.)—Saturn and its rings are observed, as have been the moon, Mercury, Venus, Mars, and Jupiter [Abstracts 794 and 2220 (1924)]. The polar caps behave similarly to those on Jupiter, while the rings exhibit the same phenomena as the moon, Mercury, and Mars. The rest of Saturn appears to be covered with a dense but clear atmosphere with cloudy zones. A. Wh.

**1045.** *Elements and Opposition Ephemeris of Minor Planet YO 11.* **A. D. Maxwell.** (Lick Observat. Bull. 11. No. 358. p. 190, 1924.)—This planet was discovered on Nov. 11, 1923. The ephemeris is given from Jan. 2 to March 31, 1925. M. A. E.

**1046.** *Corrections to the Moon's Motion from Occultations from 1880 to 1922.* **H. S. Jones.** (Roy. Astron. Soc., M.N. 85. pp. 11–35, Nov., 1924.)—Occultations observed at the Cape Observatory are discussed.

Corrections to Brown's tables and the Hansen-Newcomb tables are given for mean longitude and comparison is made with corrections derived from Greenwich meridian observations. The correction to Brown's longitude of the moon's perigee (epoch 1900·0) is $-1''\cdot64 \pm 0''\cdot33$ and to Brown's longitude of the moon's node (epoch 1900·0) is $+1''\cdot87 \pm 0''\cdot59$. The eccentricity of the moon's orbit is $0\cdot054900392 \pm 0\cdot000000097$, the derived semi-diameter of the moon is $932''\cdot70 \pm 0''\cdot04$ and the coefficient of the principal term of the parallactic inequality is $125''\cdot15$. Stress is laid on the probable freedom of the latter two quantities from systematic errors and the value derived for the solar parallax, $8''\cdot805 \pm 0''\cdot005$, can be considered a close approximation. Hink's value derived from the Eros observations is $8''\cdot806 \pm 0''\cdot004$.
A. Wh.

**1047.** *Researches on the Variation of the Luminous Intensity of the Moon during the Total Eclipse of August* 14, 1924. **G. Armellini-Conti** and **G. Armellini.** (Accad. Lincei, Atti, 33. ii. pp. 213–217, Oct., 1924.)—Work done at the Rome Astronomical Observatory on the Campidoglio. The method adopted was that recommended by G. Müller, and consists in obtaining a reflection of the moon on a little sphere of silvered glass and measuring by means of an ordinary photometer the luminous intensity of the small artificial star thus produced. The instrument should be so placed that moon and sphere are approximately in opposition with respect to the photometer. One of the advantages of this method is that if the dimensions of the sphere be small relatively to its distance from the photometer, an error in the position of the latter does not affect the results. A summary of the observations leads to the following conclusions: (1) The total luminous intensity from the moment of entering the earth's shadow till that of total eclipse varies approximately according to parabolic law. (2) At the moment when, covered by the penumbra, the moon begins to enter the earth's shadow, its luminous intensity equals nine-tenths of that of full moon. (3) Its luminous intensity when totally eclipsed is about one-fortieth of that of full moon.
E. F.

**1048.** *Observations of Mars in* 1924. **T. E. R. Phillips.** (Roy. Astron. Soc., M.N. 85. pp. 179–184, Dec., 1924.)—Between June 23 and November 30 twenty-five whole-disc drawings and sketches of particular features were made, some of which are here reproduced. Although the south polar cap diminished greatly, it never entirely disappeared, as in 1894, near sunspot maximum; thus the relation between the melting of Martian snows and the sunspot cycle, announced by Antoniadi and by Shajn of Pulkovo, is confirmed. Deformations of the terminator, suggesting the formation of cloud, were twice clearly seen.
M. A. E.

**1049.** *Types of Periodic Solutions of the Problem of Three Bodies,* **W. W. Heinrich.** (Comptes Rendus, 180. pp. 45–47, Jan. 5, 1925.)—In recent publications the author has obtained series expressing the coordinates as functions of the time. In the course of these investigations certain classes of solutions have been discovered which are designated "of the second sort." The characteristics of the two sorts of solutions are that in the first the eccentricity vanishes with the disturbing parameter, while in the second sort the eccentricity remains finite under this condition. No actual detail is given in this paper.
A. Wh.

## LIGHT.

**1050.** *Colour.* **L. C. Martin.** (Roy. Soc. Arts, J. 73. pp. 196–212, Jan. 16; 222–239, Jan. 23, and pp. 249–264, Jan. 30, 1925. Cantor Lectures.)—Gives a general discussion of the principal problems connected with colour, including the colour of transmitting and reflecting materials, the production of artificial daylight, colour vision and methods of colour analysis, colorimetry, etc. A number of instruments are described, but the paper forms a general *résumé* of the subject. J. W. T. W.

**1051.** *Total Reflection of Light.* **A. Schuster.** (Roy. Soc., Proc. 107. pp. 15–30, Jan. 1, 1925.)—The chief results of this mathematical investigation are as follows: (1) The light which enters the optically rarer medium at or beyond the critical angle is an effect of diffraction; (2) the diffracted light derives its energy from the incident beam, and must diminish the intensity of the reflected light; (3) it follows that there can be no total reflection in the strict sense; (4) at the critical angle the light dissipated by diffraction is about 1 % of the incident light when the length of the refracting surface is 3 cm. E. H. B.

**1052.** *The Optical Constants of Solid Cæsium.* **J. B. Nathanson.** (Phys. Rev. 25. pp. 75–84, Jan., 1925.)—The index of refraction and the coefficient of absorption were determined by the polarimetric method. The absolute index of refraction was obtained from the observed value by multiplying the latter by the index of refraction of the glass, the coefficient of absorption remaining the same. The index of refraction was found to vary from 0·362 for λ4550 Å. to 0·350 for λ6800 Å., with a minimum value of 0·321 for λ5890 Å. The coefficient of absorption increased from 2·37 for λ4550 Å. to 4·34 for λ6800 Å. The principal angles of incidence and of azimuth, calculated by means of Drude's formulas, increased from 55° 25′ and 38° 32′ respectively for λ4550 Å. to 63° 20′ and 40° 6′ for λ6800 Å. The corresponding values of the reflecting power were 44·2 and 66·1%. The computed reflecting power of cæsium in contact with crown glass increased from 48·5 % for λ4550 Å. to 63·2 % for λ6800 Å. A direct spectrophotometric determination yielded corresponding values of 37·2 and 63·2 %, the agreement being best in the yellow and red end of the spectrum. AUTHOR.

**1053.** *Index of Refraction for Visible Spectrum of Air between 0° and 100° C.* **A. Pérard.** (Comptes Rendus, 180. pp. 49–51, Jan. 5, 1925.)—After considering separately the effects of wave-length of light, temperature, and pressure of the air, the following formula is given as representing its index of refraction N:

$$(N-1)10^6 = \left(288\cdot02 + \frac{1\cdot482}{\lambda^2} + \frac{0\cdot0309}{\lambda^4}\right)\cdot\frac{h}{760}\cdot\frac{1}{1+0\cdot003716\theta}$$

where λ is the wave-length in microns, *h* the pressure in mm. of mercury, and θ the temperature in degrees centigrade. E. H. B.

**1054.** *Double Chronaxy in the Human Eye.* **G. Bourguignon** and **R. Déjean.** (Comptes Rendus, 180. pp. 169–172, Jan. 12, 1925.)—

The making and breaking of a continuous current passing *via* the human eye causes a sensation of light, and this phenomenon is utilised by the authors to measure the chronaxy of the human eye. The paper is purely physiological. B. J. L.

**1055.** *The Absorption of Ultra-violet Rays by the Methyl Derivatives of Naphthalene.* **H. de László.** (Comptes Rendus, 180. pp. 203–206, Jan. 19, 1925.)—A large number of these derivatives have been examined dissolved in hexane and as vapours. The absorption spectra of the monomethyl and dimethyl derivatives closely resemble that of naphthalene. There is a region A between $\lambda = 3250$ and 2950 Å., another B between 2950 and 2500, and a very strong one C in the extreme ultra-violet, $\lambda = 2200$ Å. Curves are given showing the absorption spectra of naphthalene, $\beta$-$CH_3$ naphthalene, and 2–6 and 2–7 dimethylnaphthalene dissolved in hexane. Various differences between the different parts of the spectra are noted; in region B the narrow bands of naphthalene fuse together in the derivatives. The bands in region A can, in each derivative, be grouped in several series with almost constant intervals; these range from $\Delta(1/\lambda) = 1380$ cm.$^{-1}$ for 2–6 dimethylnaphthalene to 1540 cm.$^{-1}$ for $\alpha$-methylnaphthalene, the value for naphthalene itself being 1450 cm.$^{-1}$. The corresponding interval for benzene is 921·4, for toluene 932·5, and for paraxylene 1184 cm.$^{-1}$. The introduction of $CH_3$ groups in the molecule causes a displacement of the spectrum towards the red, which is greater for the $\beta$ than for the $\alpha$ derivatives, that of the 2–6 one being most shifted. The bands in the $\beta$ derivatives are more pronounced and more numerous than in the $\alpha$ ones; this is a general result obtained with derivatives containing the groups $CH_3$, OH, $NH_2$, CN, COOH, Cl and Br. The position 2–6 gives spectra which are more intense with more numerous bands shifted more towards the red than position 2-7; there is a great analogy here with the para derivatives of benzene as compared with the ortho and meta derivatives. H. N. A.

**1056.** *Absorption Coefficients of Liquids and their Vapours in the Infra-red.* **T. Dreisch.** (Zeits. f. Physik, 30. 3. pp. 200–216, 1924.)—The absorption of water, benzol, and chloroform has been measured in the liquid and gaseous states up to 3 $\mu$, using a quartz prism. The liquids absorb more strongly than the vapours, but this is reversed between 1·5 and 2 $\mu$. A. C. M.

**1057.** *Study of Astronomical Objective.* **G. Demetrescu.** (Rev. d'Optique, 3. pp. 531–535, Dec., 1924.)—An investigation by Hartmann's method of a Zeiss objective of 20 cm. aperture and 3 m. focal length. The diaphragm employed contained 69 circular openings of 8 mm. diameter, placed down and across at distances of 14·6 mm. A dry gelatine-on-glass colour screen (coloured by tartrazine) was placed in contact with an orthochromatic plate, and photographic images, almost round, of $\alpha$ Lyræ (when near the zenith) were procured in the D region of the spectrum. A table of results is given. The author obtains the values: $\sigma_1'' = 0''\cdot 56$; $s = 11''\cdot 15$; $c = 0'\cdot 84$ [for these coefficients see Abstract 1431 (1924)], showing that the focal images, considered from the point of view of geometrical optics, scarcely exceeds the theoretical diffraction disc. The value of $c$ as compared with that for other objectives bears witness to remarkable optical qualities, but the astigmatism is not so satisfactory. A. S. D. M.

**1058.** *Image Curvature as a Function of Diaphragm Position.* **I. C. Gardner** and **J. J. Arnaud.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 675–683, Dec., 1924.)—Taylor's formulæ for the curvatures of the astigmatic image surfaces produced by a combination of elements are here suitably simplified for practical purposes. If the modified curvatures (primary and secondary) are plotted against the distance *d* on the axis from the element to the entrance pupil point, two parabolas are obtained with axes perpendicular to the *d*-axis and intersecting at two points for which the curvatures are equal to the Petzval curvature. Such a graph is shown, and its utility discussed for the design of an eyepiece. An illustration is also given of the manner in which the discrepancy between the trigonometric and Taylor curvatures increases with increase of field under consideration. H. H. Ho.

**1059.** *Apparatus to Photograph the Whole Sky.* **C. Beck.** (Journ. Sci. Instruments, 2. pp. 135–139, Jan., 1925.)—Some form of preliminary reduction of the angle of view is required before taking a photograph which includes a field of 180°. A highly divergent meniscus lens, designed by R. Hill, is used for this purpose. The different forms of distortion, one of which is necessary to project an angle of view of 180° upon a flat surface, are discussed, and previous attempts to reproduce the field of view as seen by a fish are outlined. The method of reproducing normal photographs from small portions of the complete photographs is described. AUTHOR.

**1060.** *Interferometer Methods of Measuring Close Double Stars and Fixed Star Diameters.* **K. F. Bottlinger.** (Zeits. Instrumentenk. 44. pp. 540–555, Dec., 1924.)—A description, with illustrations, of the various forms of stellar interferometers in use. A bibliography is appended. E. F.

**1061.** *Latest Form of Zeiss Theodolite.* **W. Schermerhorn.** (Zeits. Instrumentenk. 45. pp. 16–35, Jan., 1925.)—Describes in detail the construction and performance of a new theodolite made by Zeiss for the geodetic institute of the Technische Hochschule at Delft. The performance is compared with that of other instruments of recent construction by other makers. J. W. T. W.

**1062.** *Performance of Optical Systems with Reference to Diffraction.* **R. Richter.** (Zeits. Instrumentenk. 45. pp. 1–15, Jan., 1925.)—In continuation of K. Strehl's work [see Abstract 205 (1903)], the author studies the definition of an optical system as given by diffraction considerations. The paper is mainly mathematical and cannot be usefully abstracted. J. W. T. W.

**1063.** *Interference Method for Measuring Constants of Diverging Optical Systems.* **V. Ronchi.** (Accad. Lincei, Atti, 33. ii. pp. 314–318, Nov. 2, 1924.)—Describes a direct method for studying the aberrations of a diverging optical system without the necessity for combining it with a more powerful converging system. A grating is placed in the path of the divergent beam, and the form of the fringes received on a screen placed at a given distance from this grating enables the aberration of the system to be determined. [See Abstract 80 (1925).] J. W. T. W.

**1064.** *Some Problems in the Theory of Optical Diffraction.* **E. T. Hanson.** (Optical Soc., Trans. 26. 1. pp. 1–11; Disc., 12–13, 1924–1925.)—The diffraction of waves by a perfectly reflecting wedge is a problem of considerable celebrity. The diffraction of waves by a straight slit in a plane screen is a problem not yet exactly solved; it occupied Rayleigh's mind for many years. This paper gives a brief treatment of points of novelty and interest in these two problems. E. H. B.

**1065.** *Back Vertex Power of a Conbination of Lenses.* **T. Smith.** (Optical Soc., Trans. 26. 1. pp. 31–37, 1924–1925.)—The general relations between the constants of a compound instrument and those of its components are obtained when the imagery is collinear. From these relations the expression for the vertex power of a compound instrument is built up in the form convenient for application in spectacle calculations, and in other cases. E. H. B.

**1066.** *Theory of Neutralisation.* **T. Smith.** (Optical Soc., Trans. 26. 1. pp. 38–45; Disc., 46, 1924–1925.)—Reasons are given for rejecting the current theory of neutralisation, and a new theory is propounded which represents more exactly the experimental procedure. It is shown that the test should be made with a large separation between the test object and the eye, and that the connection between the vertex powers of the lenses when neutralisation is exact involves the distance of the test object and the order in which the lenses are placed. From the discussion of numerical results it is concluded that the simple law of the zero sum for the vertex powers is attained with ample accuracy as a mean result. Plano-lenses should be tested with their *plane* surfaces in contact. E. H. B.

**1067.** *Colour Correction of an Achromatic Doublet.* **T. T. Smith.** (Optical Soc. of America, J. and Rev. Sci. Inst. 10. pp. 39–63, Jan., 1925.)—A general consideration of the subject leading to expressions for (1) the variation in focal length of an achromatic doublet in terms of the Hartmann interpolation formula, and (2) the variation in intensity on the axis of a lens in the neighbourhood of the principal focus. Numerical results are given in a special case (ordinary crown and dense flint) for the luminous efficiency of a lens of any dimensions in so far as this efficiency is controlled by the chromatic aberration. It is shown that for ordinary glasses the chromatic aberration and the colour variation of the spherical aberration are of the same order of magnitude. The author concludes that an appreciable improvement in the spherical correction would probably result from the use of a wave-length in the neighbourhood of 550 $m\mu$ as a standard, at any rate for visual work. J. W. T. W.

**1068.** *Refraction and Dispersion in the Light-Quantum Theory.* **L. S. Ornstein and H. C. Burger.** (Zeits. f. Physik, 30. 4–5. pp. 253–257, 1924.)—With the aid of the linear dimensions of light-quanta, previously found [Abstracts 1450 and 1451 (1924)] to be of the order of magnitude of a wave-length, the retardation of light in matter is explained, and Rayleigh's formulæ for dispersion by atoms can be deduced. A. D.

**1069.** *Diffusion of Light in Fluids.* **Y. Rocard.** (Comptes Rendus, 180. pp. 52–53, Jan. 5, 1925.)—The work is published for comparison with that of Martin [see Abstract 543 (1925)]. The depolarisation $\rho$ of light passing along $0x$ through a liquid and viewed along $0y$ is defined to be the ratio of the intensity along $0x$ to that along $0z$. The great difficulty is the preparation of optically pure liquids—that is, free from dust and colloids in suspension. This is specially difficult for water, for which $\rho = 0{\cdot}11$ for given light, but can be achieved by ultra-filtration. Results in the blue may be affected by a slight fluorescence attributed to solution of the containing vessel, so that $\rho$ may rise to 0·16 and 0·18 in the blue and violet. Nitrobenzene and benzonitrile were chosen for experiment, as they are strongly anisotropic. Benzonitrile gives $\rho = 0{\cdot}65$ for red light, for which only it is transparent, while nitrobenzene has values for $\rho$ of 0·68, 0·67, 0·68 and 0·75 for the red, yellow, green and blue violet. These values agree with Martin's, except in the blue. The author proposes a theory of change of depolarisation due to an electric field on the assumption that molecular anisotropy is the sole cause, and calculates a change of only 1 part in 200 would arise from a field of 100,000 volts per cm. This is taken to explain Martin's observation that a magnetic field is without effect. F. S.

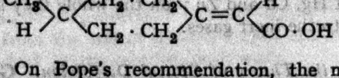
**1070.** *A Test of the Classical Dispersion Formula for Monatomic Gases and Vapours.* **K. F. Herzfeld** and **K. L. Wolf.** (Ann. d. Physik, 76. 1. pp. 71–105, Jan., 1925.)—The available measurements of refractive index for He, Ne and Ar are investigated and tabulated, curves being given showing the relation of $n - 1$ to wave-length. The dispersion can in each case be represented by a single term formula, which places the natural frequency of the atom on the ultra-violet side of the long wave-length boundary of the ultra-violet absorption spectrum. It is not possible to decide if this natural frequency is the "centre of gravity" of the continuous spectrum. An attempt to explain the dispersion by means of the resonance line alone did not lead to any result; it was possible, however, in the cases of He and Ar, to obtain formulæ with two terms, the natural frequency of the least important of which corresponded to the resonance voltage. These formulæ agree with the observations no better and no worse than the single term ones. The calculated number $p$ of the number of electrons acting per molecule increases greatly from Ne to Ar, and a little from Ar through Kr to Xe. This, and the greater curvature of the two theoretical argon curves as compared with the experimental curve, make it probable that the lower levels of the atom are also concerned in the phenomena. It is possible to explain the results, however, by assuming a deviation from the classical theory, such as is required by Wentzel's theory. No definite formulæ could be obtained for the vapours of Hg, Cd and Zn; on the whole they seem to behave in a similar manner to the inert gases. H. N. A.

**1071.** *Note on the Theory of Optical Dispersion.* **G. Breit.** (Washington Acad. Sci., J. 15. pp. 34–39, Jan. 19, 1925.)—The attempts of Sommerfeld and Debye to account for optical dispersion by studying the perturbations caused in the electronic motion by the incident wave were unsuccessful because the frequency at which the calculation showed the reaction to be strongest proved to be the frequency of revolution of the electron and not the absorption frequency given by the relation $\Delta\omega = h\nu$.

The difficulty was avoided by Ladenburg, Reiche, and Kramers, but in their theories the dispersion is discussed only for frequencies which do not lie in the absorption band. For this reason the equivalent classical resonator is not supposed to have any dissipation of energy, and the present paper discusses how far it is necessary to introduce the dissipation of energy into the theory. On the classical theory a frictional term in the equations of motion could be interpreted as due to radiation, but on the quantum theory there is no continuous radiation, so the author investigates the possibilities of a classical resonator without a frictional term, adopting van Vleck's notation [see Abstract 322 (1925)]. It is shown that the phase change introduced by the classical frictional force may be also thought of quantitatively as due to the interrupted action of the resonator. If the correspondence principle may be applied in this case, and if it is to be interpreted as assigning a certain similarity to the actual dispersion and the theoretical classical dispersion, then any other influence than that of interrupted actions in the higher quantum states has to be abandoned. If the width of emission and absorption lines be related to the dispersion by the laws of the classical theory, then this width is entirely due to the finite time of each independent emission. The theory of interruptions now put forward is claimed to account for the polarisation of resonance radiation in weak magnetic fields in a more satisfactory manner than the classical resonator. H. H. Ho.

**1072.** *Diagrams of Radiation from Ultra-Microscopic Particles.* **R. Gans.** (Ann. d. Physik, 76. 1. pp. 29–38, Jan., 1925.)—Mie [Abstract 594 (1908)] has shown that gold spheres of 160–180 $\mu\mu$ diameter and suspended in water scatter more strongly in the direction of the original beam than in the opposite direction, a result not in agreement with those for indefinitely small particles. Calculations have been made by the author of the intensity of scattering in various directions for silver particles of 125 $\mu\mu$ and 153 $\mu\mu$ illuminated with light of $\lambda = 525\ \mu\mu$, polar diagrams being drawn. For non-conducting particles the reverse is the case, strongest scattering occurring in the opposite direction to that of the incident beam. An experimental arrangement is described for verifying the preceding distinction. W. V. M.

**1073.** *Rotatory Dispersive Power of Organic Compounds—Simple Dispersion in 1-Methylcyclohexylidene-4-Acetic Acid.* **E. M. Richards** and **T. M. Lowry.** (Chem. Soc., J. 127. pp. 238–240, Jan., 1925.)—Special interest attaches to the rotatory dispersion of centro-asymmetric compounds, which, according to the ordinary definition, contain no asymmetric atom. The *d*- and *l*-forms of the well-known acid,



$$\begin{array}{l}\mathrm{CH_3}\\ \mathrm{H}\end{array}\!\!>\mathrm{C}<\!\!\begin{array}{l}\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{array}\!\!>\mathrm{C{=}C}<\!\!\begin{array}{l}\mathrm{H}\\ \mathrm{CO\cdot OH}\end{array}$$

are investigated. On Pope's recommendation, the measurements are made with solutions in methylal. The volatility of this solvent makes it necessary to express the results in the form of dispersion-ratios instead of by means of specific or molecular rotations, since the solutions are originally cloudy and their concentrations are altered appreciably by filtration; there is, however, the very great advantage of being able, except in the photographic region, to read a dextro against a lævo solution, under precisely similar conditions, without being compelled to make use of zero-readings. In these circumstances a very satisfactory agreement is obtained between the results recorded in two complete series of independent readings. The data are set out in a table together with the corresponding dispersion-ratios calculated from the equation $a/a_{5461} = 0 \cdot 2422/(\lambda^2 - 0 \cdot 056)$. The data can be expressed, over the range of wave-lengths covered by these experiments and up to the existing limits of experimental accuracy, by one term of Drude's equation. Moreover, since an exposure of more than an hour is required to give the last photographic reading, it is clear that the measurements are carried right up to the limit of the region of transparency, within which alone Drude's formula is valid. As a result of these experiments, and until some positive evidence to the contrary is available, it is proposed to describe the dispersion of the compound as simple. A. E. G.

**1074.** *Rotatory Power of Cholesterol Substances.* **Royer.** (Comptes Rendus, 180. pp. 148–150, Jan. 12, 1925.)—Further results [see Abstract 1987 (1922)] lead to the following conclusions: The enormous rotatory power characteristic of substances exhibiting a cholesterol phase is due to the peculiar structure of this state, and is explained by the existence of considerable spontaneous torsion, coupled with marked double refraction. The greater the torsion, the smaller is the rotatory power. Like the magnetic rotation, as a rule the "cholesterol" rotatory power decreases as the temperature is raised, whereas the molecular rotatory power of crystals often increases with rise of temperature. As regards the magnitude of the cholesterol rotatory power, this is much greater in mixtures containing only a small proportion of the active substance than when a large amount of the latter is present. The rotatory dispersion of these cholesterol substances also exhibits special characters, inversion of the rotatory power occurring in many cases at a certain wave-length.
T. H. P.

**1075.** *Kinematography with a Continuous Movement of Film: Very High-Speed Photography.* **J. Barot.** (Rev. d'Optique, 3. pp. 513–530, Dec., 1924.)—Describes two systems of kinematography in which the negative is taken and the positive shown with a continuously moving film. Each system depends on compensating for the movement of the film during an exposure by a corresponding movement of a plane mirror included in the optical system. In the second part of the paper a description is given of the apparatus of Heape and Grylls, by means of which it is possible to take from 500 to 5000 photographs per second.
J. W. T. W.

**1076.** *Basis of Heterochromatic Photometry.* **C. Schaefer.** (Phys. Zeits. 26. pp. 58–64, Jan. 1, 1925.)—By means of the Ostwald colour atlas or similar system of colours it is possible to travel round a complete colour cycle in any desired number of steps. The author has made photometric measurements, step by step, round a complete cycle, using (*a*) a direct comparison, and (*b*) a flicker photometer, in order to determine whether the commutative law is valid for these two methods of heterochromatic photometry. He finds that if too few steps are taken the individual comparisons become inexact, owing to the large colour differences involved; if, on the other hand, the steps are small, the accumulated error at the end of the cycle is large. With twelve steps he finds that both systems are valid to about 3 or 4 %, and this must be regarded as within the experimental error. J. W. T. W.

**1077.** *The Properties of Photographic Reversal Phenomena.* **H. Arens.** (Zeits. phys. Chem. 114. pp. 337–386, Jan. 20, 1925.)—An investigation is made of the phenomenon of the reversal of a photographic image which is due to the property that on progressive exposure the developability, after increasing to a maximum or solarisation limit, falls on further exposure, when the image, after developing, changes from a negative to a positive. The work has enabled the recognition of three types of photographic reversal phenomena. In the first type it is shown that the exposure to light causes the formation of finely-deposited silver, which is very reactive to the developer and forms the normal latent image. This silver acts catalytically on the development of further silver salt. On further exposure the silver becomes compact by aggregation and loses its catalytic properties. The essential characteristics of the second type is oxidation by light of the silver of the granules in the presence of Br. mols. or ions. The third type is based on diffusion of the bromine, which is liberated by the action of light from the interior of the granules, and on reaching the surface reacts again with the silver, reversing the original photo reduction. The different points which are investigated include solarisation in the presence of halogen absorbing agents; the resistance of the silver of the latent image against silver bromide solvents; the Ag content of the solarisation image; the ability of different forms of Ag to act as nuclei; the resistance of the solarisation image against oxidising agents; the effect of desensitisers in relation to their light absorption. The properties of the Herschel effect are discussed. Measurements are made of the relative effects of Röntgen and solar radiation and the influence of time of exposure and nature and concentration of developer necessary to cause the reversal effect. [See Abstract 832 (1924).] J. N. P.

**1078.** *Action of Light on the Ferrous Ferric Iodine Iodide Equilibrium.* **E. K. Rideal** and **E. G. Williams.** (Chem. Soc., J. 127. pp. 258–269, Jan., 1925.)—The reaction $2Fe^{\cdots} + I_2 \rightleftarrows 2Fe^{\cdot\cdot} + 2I'$ is photosensitive to both ultra-violet and visible light, the region of visible photoactive radiation being within the range 5500–6500 Å., with an apparent maximum at 5800 Å. The tri-iodide ion is the photoactive constituent, and the energy of excitation corresponding with the wave-length 5800 Å. is equivalent to 2·14 volts, a value almost identical with the resonance potential of the iodine molecule. One quantum of absorbed radiant energy causes 1 mol. of iodine to react, and the mechanism of the reaction can be expressed in the form $\overbrace{2FeI_2 + I_3'} + h_\nu = 2FeI_3 + I'$. The dark equilibrium constant of the reaction is $K = 23{\cdot}6 = (Fe^{\cdots})(I_2)^{\frac{1}{2}}/(Fe^{\cdots})(I')$ at 25°. The temperature coefficient of the liberation of iodine in the dark is $k_{35} : k_{25} = 2{\cdot}713$, that of the photochemical reaction being 1·17. Addition of potassium chloride raises the thermodynamic concentrations of all the reactants, and although the equilibrium point is unchanged, the rate of attainment is very considerably increased. Proof is furnished that equilibrium is the result of attainment of equal velocities of the forward and the back reaction, since the effect of radiation of constant intensity on the equilibrium attained is less when the thermodynamic concentrations of the reactants (and thus the velocities of the two reactions) are raised by addition of potassium chloride. T. H. P.

**1079.** *Influence of the Basic Material on the Emission of Phosphorescence.* **R. Tomaschek.** (Phys. Zeits. 25. pp. 643–646; Disc., 646, Dec. 1, 1924. Paper read before the Deut. Naturforscher u. Ärzte, Innsbruck, 1924.)—When the base materials used consist of sulphides of the alkaline earth metals [see Abstract 2960 (1924)], as the atomic weight of the metal increases, displacement of the phosphorescence spectrum towards the region of smaller wave-length occurs, the separation of the two lines of the doublets at the same time becoming less. If the sulphur atom is replaced by an oxygen atom, the displacement is in the opposite sense, and the doublets open out. These displacements are in the opposite direction to those which would be indicated by the influence of the dielectric constant. On the basis of Lenard's conceptions, a hypothesis concerning the structure of the phosphorescence centres is advanced to explain the above observations, and various consequences of this hypothesis are discussed. T. H. P.

**1080.** *Note on the Least Mechanical Equivalent of Light.* **H. E. Ives.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 635–638, Dec., 1924.)—The author has formerly determined the least mechanical equivalent by means of the monochromatic green mercury line ($\lambda$5461), the luminous value and the radiant value (energy value) of which were determined [Abstract 838 (1915)]. The watts per lumen were found to be 0·00163. This, multiplied by the luminous efficiency of this wave-length, which is nearly unity (maximum efficiency being rated as unity), gives the least mechanical equivalent of light. A complex radiation may be used if all its elements are given their proper rating in luminous efficiency. This can be done in the case of black body radiations, the relations of which are accurately expressed by a well-verified formula, though the constants are not as yet known with the accuracy required. Recently two fundamental points have been determined: Gibson and Tyndall have determined accurately the luminous efficiency curve of the spectrum, and the author the brightness of the black body at the melting-point of platinum. An equation is deduced for $m$, the mechanical equivalent of light, which incorporates the Planck black body equation and Gibson and Tyndall's experimental curve. Inserting the recently determined value of the brightness of the black body at the melting-point of platinum (55·4 c.p. per sq. cm.), and taking the most probable value of the melting-point as 2035° abs., with recent values for the fundamental constants, the value $m = 0 \cdot 00161$ watts per lumen is obtained. Multiplying the result previously obtained for the Hg line by the luminous efficiency of wave-length $0 \cdot 5461\ \mu$, as taken from Gibson and Tyndall's curve—namely 0·985—the value of $m$ is given as $0 \cdot 00160_5$ watts per lumen, which agrees with the black body measurement. H. N. A.

**1081.** *On the Theory of Quantum Radiation.* **P. Jordan.** (Zeits. f. Physik, 30. 4–5. pp. 297–319, 1924.)—After a short description of the Einstein [see Abstract 654 (1917)] and Bohr theories, it is shown in this paper that a theoretical necessity for recoils $h\nu/c$ does not arise in the consideration of thermal equilibrium, but that a simple generalisation of the Einstein theory is possible which involves no specialised assumptions as to recoils in the radiation. The opportunity is also afforded and taken of dealing with other problems of radiation theory. H. H. Ho.

**1082.** *Reflection of Waves Penetrating Normally into a Stratified Medium.* **J. A. Wilcken.** (Phil. Mag. 49. pp. 107–112, Jan., 1925.)—The author here seeks to establish a general expression for the relative intensity of a reflected wave, without special assumptions except as to the reversibility implied in the linear equation of motion. To avoid the complications arising from the change in direction due to oblique incidence, which the author has recently discussed [see Abstract 2505 (1924)], he considers a train of waves in the direction of $+x$ and impinging normally at the boundary, $x = 0$, of a plane stratified medium, and takes as equation of motion free from the time $d^2U/dx^2 + k^2U = 0$, where $k$ is a real continuous function of $x$, $k = 2\pi/\lambda = 2\pi n\mu/c$, $k^{x \leq 0} = k_0$. By considering special cases, two interesting results are obtained: (1) Reflection from a continuously varying transition layer depends primarily on the discontinuity of the gradient of the refractive index, and (2) there is no reflection when the refractive index and its gradient are continuous throughout. Even a small change in the thickness of the layer may cause an appreciable relative change in the reflected intensity. G. W. de T.

**1083.** *Radiation Quanta and Ideal Gas Theory.* **A. Schidlof.** (Arch. des Sciences, 6. pp. 281–293, Sept.–Oct., and pp. 381–392, Nov.–Dec., 1924.)—In a note to a paper by Bose on Planck's Law and the Light Quantum Hypothesis [Abstract 2812 (1924)], Einstein suggests the use of the method there developed for the application of the quantum theory to the case of an ideal gas. The author carries this out in the present paper, the greater part of which consists in the reproduction of the argument and analysis of Bose's paper and of Einstein's original paper on the Quantum Theory of Radiation [Abstract 654 (1917)]. G. W. de T.

**1084.** *The Paschen-Back Effect.* **C. Runge.** (Ann. d. Physik, 76. 2–3. pp. 266–272, Jan., 1925.)—A theoretical paper in which the two following results are arrived at. The deviation of the Sommerfeld representation of the Paschen-Back effect from Voigt's formula does not correspond with the facts, and in Kent's observations of the magnetic splitting of line 6708 Å.U. the behaviour of component 7 is not compatible with the author's views of the term analysis of the lines of the spectrum. A. E. G.

**1085.** *The Influence of the Length of the Radiating Column on the Width of Spectral Lines.* **B. Venkatesachar.** (Phil. Mag. 49. pp. 33–59, Jan., 1925.)—The author recalls the suggestions of Lord Rayleigh [Abstract 555 (1915)] giving probable causes of the widening of spectral lines. After a brief note on previous work, the paper describes theoretically and practically the striking increase in brightness of the line 5461 Å. in the spectrum of radiation from a low-density mercury-vapour lamp. The lamp used is described in detail, and provided a long radiating column of mercury-vapour. The paper includes tables of results and plates of actual records. The question of the visibility of interference fringes produced by the axial radiation from a luminous column of finite length in a Michelson interferometer is investigated, and the paper concludes with a discussion of the application of the data to astronomical observations and temperatures of nebulæ, etc. S. G. B.

**1086.** *Remarks on Spectroscopic Displacement Laws.* **E. Fues.** (Ann. d. Physik, 76. 2–3. pp. 299–316, Jan., 1925.)—The displacement of spectral lines with ascent of atomic weights are described in terms of the theoretical results of Sommerfeld and Kossel based upon the Bohr atom. These are treated from the theoretical aspect, and the results permit of prediction of other lines. The treatment is too involved and the results too largely tabular to permit of brief abstraction. B. J. L.

**1087.** *Width of the Balmer Lines in an Oscillating Discharge.* **(Miss) M. Hanot.** (Comptes Rendus, 180. pp. 54–56, Jan. 5, 1925.)—This is a continuation of previous work [see Abstract 1802 (1924)]. The effect of period of oscillation, capacity and difference of potential is studied. The first is determined from the wave-length as measured by a wireless wave-controller; the capacity was formed by a battery of Moscicki condensers; and the last-named by the length of spark. The Balmer lines were photographed with a Rowland concave grating, and the width determined by a Fabry-Buisson microphotometer. It is concluded that for given initial temperature and pressure the maximum intensity of current in a feebly-damped oscillating spark determines the width of the lines. F. S.

**1088.** *Spectroscopy in the Past and in the Future.* **C. Fabry.** (Frank. Inst., J. 199. pp. 13–25, Jan., 1925.)—This address contains a clear *résumé* of apparatus both for separating and for recording radiations. A short historical account of accurate wave-length measurement follows. F. S.

**1089.** *Ultra-violet Absorption in Petroleum.* **F. Vlès** and **(Miss) M. Gex.** (Comptes Rendus, 180. pp. 140–143, Jan. 12, 1925.)—An examination has been made of the ultra-violet spectrophotometric curves of crude petroleum oils in the region between $\lambda 220\ m\mu$ and the visible range, as well as observations on the various separation products. The bodies were examined in solution in $CHCl_3$, using thicknesses of the order of 0·2 to 1·5 mm. [Abstract 1639 (1922).] Five bands have been observed with maximum intensities at 300, 280, 265, 242 and $< 240\ m\mu$ respectively. During the refining processes the relative importance of the bands changes, but it is impossible up to the moment to determine with certainty the nature of the constituents to which the various bands correspond. W. V. M.

**1090.** *The Absorption of Ultra-violet Rays by the Skin and its Therapeutical Applications.* **J. Saidman.** (Comptes Rendus, 179. pp. 1448–1450, Dec. 15, 1924.)—In ultra-violet radiation therapy the question arises whether the therapeutic effect is dependent merely upon intensity or upon intensity and wave-length. The author divides such radiations into eubiotic above 3000 Å.U. and abiotic below 3000 Å.U. That radiation which is most efficacious for the treatment of rickets is unsuitable for the treatment of localised tubercular lesions, and *vice versa*.

The author has carried out spectrographic absorbtion experiments with fresh histological specimens of skin, and finds that the radiation from the mercury-vapour arc is largely absorbed by the superficial layers of the skin, and a thickness of 1 mm. allows the passage of only violet rays of the visible spectrum. The arc-lamp generator, whilst dependent upon the composition of the electrodes, has generally a lower wave-length and more penetrative radiation. This explains why an erythema can be more rapidly produced by the mercury-vapour lamp than by the arc lamp, since the radiation of the former is more rapidly absorbed by the skin. B. J. L.

**1091.** *Spectroscopic Study of the Luminescent Oxidation of Phosphorus.* **H. J. Emeléus** and **W. E. Downey.** (Chem. Soc., J. 125. pp. 2491–2495, Dec., 1924.)—The object of the work was to find whether burning phosphorus emits light of which the spectrum is similar to that of the glow. Photographs were taken with a small Hilger quartz spectrograph and the copper arc used as a comparison spectrum. To obtain the flame spectrum, air enriched with oxygen was drawn over thin stick phosphorus in a hard glass tube and the phosphorus was burnt close to the spectrograph slit, which was protected by a quartz window. The flame temperature was 800° C. Five bands were observed at $\lambda = 2390$, 2475, 2530, 2630 and 3275 Å. By burning phosphorus in a tube under reduced air-pressure a flame temperature of 125° was obtained. The spectrum shows the same bands, but resolved into smaller bands. The glow spectrum was obtained by passing air over phosphorus contained in a flat tray, which was cooled by water to prevent the phosphorus catching fire. An exposure of 200 hours shows the same narrow bands as the low-temperature flame. This contradicts Petrikaln's recent work, but agrees with the earlier work of Centnerszwer and Petrikaln. F. S.

**1092.** *Structure of Spectrum Lines of Nitrogen.* **F. Croze.** (Comptes Rendus, 179. pp. 1603–1605, Dec. 29, 1924.)—The spectrum lines which are obtained when a spark strikes in an atmosphere of nitrogen are emitted in part by the atom of nitrogen in the neutral state and in part by the atom ionised once or twice. The object of this paper is to show that the whole of this spectrum conforms to the law of alternation of multiplicities. A. E. G.

**1093.** *Structure of Spectra of the Lines of Ionised Nitrogen and Oxygen.* **F. Croze.** (Comptes Rendus, 180. pp. 277–279, Jan. 26, 1925.)—The spectrum of ionised nitrogen ($N^+$) has been considered in a previous paper [see preceding Abstract]. According to the alternation rule, the spectrum of the lines of ionised oxygen ($O^+$) ought to be formed by combinations between the terms of the multiplicity pair. Tables are given showing the more important of the combinations between the quadruple terms which the author has found in the visible portion of the spectrum by applying the rule of Landé to measurements of the Zeeman-effect. A. E. G.

**1094.** *Structure of the Second Positive Group of the Nitrogen Bands. Part III.* **P. Lindau.** (Zeits. f. Physik, 30. 3. pp. 187–199, 1924.)—New combination-relations are found for certain bands in this group. These relationships are tested by measurements on the bands 3805, 3536, 4059, and 3755, and are found to be supported by the evidence. [See Abstracts 2274 and 2965 (1924).] A. C. M.

**1095.** *The Negative Bands of Nitrogen.* **M. Fassbender.** (Zeits. f. Physik, 30. 1. pp. 73–92, 1924.)—The negative band-spectrum of nitrogen has been photographed with the largest obtainable resolving-power. All the lines have been classified, and the terms, branches, null-lines, and intensity-distributions accurately determined. A. C. M.

**1096.** *The Structure of the Spectrum of Ionised Nitrogen.* **A. Fowler.** (Roy. Soc., Proc. 107. pp. 31–42, Jan. 1, 1925.)—The present communication gives particulars of the regularities which have been recognised in the second line spectrum of nitrogen, extensive observations having been made on the spectrum of nitrogen in vacuum tubes with the gas at various pressures and under varying conditions of electrical discharge. The spectrum (NII or $N^+$) has been investigated over the range λ6650 to λ2200, but no regularities have yet been traced on the more refrangible side of λ3000. Fifty-two lines have been classified in relation to the terms which combine to produce them. In this region all the terms which have been identified belong to singlet or triplet systems. These have been found to combine with each other in agreement with the selection rules applicable to other spectra in which *p'* and *d'* terms appear. The absolute values of the terms cannot yet be stated, but a value of 70,000 has been provisionally assigned to 2*p* in accordance with the value suggested for 1*p* by astrophysical data. The largest term identified is the *p* term, and it may be inferred that the series electron in singly-ionised nitrogen normally occupies a $2_2$ orbit, so that the atom of NII has two electrons in $1_1$ orbits, two in $2_1$ and two in $2_2$ orbits. From the spectroscopic displacement law it may be further inferred that this is also the probable arrangement of orbits in the neutral atom of carbon, the spectrum of which has not yet been resolved into series. Three groups of lines which involve one of the *p* terms are remarkable as showing large displacements ($>0 \cdot 5$ Å.) to the red in vacuum tubes at relatively high pressures. W. V. M.

**1097.** *Absorption Spectrum of Potassium Vapour at High Temperatures.* **N. K. Sur** and **R. N. Ghosh.** (Phil. Mag. 49. pp. 60–64, Jan., 1925.)—The paper treats of Fowler and Milne's extension of Saha's theory of thermal excitation of elements at high temperatures, and records the work of King and Narayan on the subject. In the present work the potassium was heated in a special iron tube oven sealed at both ends by plate glass. The ends were water-cooled, and the centre heated in a special clay furnace by coal and an air blast. The temperature attained was 1300° C. The transmitted light, from a 50-c.p. pointolite, showed a green colour at 500° C., and at red-heat became bluish-green. At this point no absorption line is observed, but the spectrum is traversed by channelled bands. At 1300° C. eight absorption lines were obtained and measured, and in addition seven other absorption lines were noted and measured which could not be identified with potassium nor allotted any series relation. These are recorded. The edges of the channelled bands are regions of greater absorption and lie towards the violet. The bands are clearly seen at low temperatures (600° C.), but diminish in intensity with increment of temperature. The appearance and behaviour are described and a list of wave-lengths of the heads of the channelled bands in the orange-green region is given. S. G. B.

**1098.** *The CuH Molecule and its Band Spectrum.* **H. Bell.** (Phil. Mag. 49. pp. 23–32, Jan., 1925.)—The copper atom is studied in the light of information derived from the work of Frerich's and Bengtsson on the copper bands in the region $\lambda 4700$ to $\lambda 4000$. The paper extends the method of deduction used for halogen hydrides in a previous communication [Abstract 1169 (1924)]. A formula for band spectra in the visible spectrum is developed and applied to the copper bands above mentioned. The half-quantum for the rotating molecule is established, and the molecule identified as being CuH. The bands can be grouped into sets according to their initial and final configurations. The distances between the copper and hydrogen nuclei for the above configurations are calculated, and a diagram given showing the variation of the radial force function with distance. S. G. B.

**1099.** *The Zeeman-Effect of Neon.* **E. Back.** (Ann. d. Physik, 76. 2–3. pp. 317–322, Jan., 1925.)—This paper consists of an extended description of the experimental arrangements, followed by tables of data obtained by its use. These data exactly satisfy the theoretical predictions of Landé, and the correspondences with other results due to Runge and to Preston are discussed. B. J. L.

**1100.** *The Square Term in the Zeeman-Effect.* **A. Landé.** (Zeits. f. Physik, 30. 4–5. pp. 329–340, 1924.)—Allowance is made in the calculation of the strength of the field for square terms; this leads to a closer approximation, which is verified in the cases of strong fields. The formulæ of Born and Pauli are completely included in Heisenberg's new quantum-principle. Mainly mathematical. A. C. M.

**1101.** *Dependence of $K_{\alpha}$ Doublet on Chemical Constitution.* **B. B. Ray.** (Phil. Mag. 49. pp. 168–170, Jan., 1925.)—Several workers have noticed a change in the absorption edges of elements of low atomic number, such as P, S and Cl, with differing chemical conditions—for example, valency. Siegbahn and the author have also noticed that the $K_{\alpha}$ separation does not vary regularly from element to element in the iron group when pure metals or monovalent salts are used. This work is now extended to the elements Cl, K, V and Fe in salts of varying valencies. A Hadding tube was used in conjunction with a vacuum spectrograph and calcite crystal. A current of 10 m.a. at 50 kv. was used, and exposures of ten minutes sufficed. The salts were pressed upon a roughened copper antikathode. In all cases it was found that the $K_{\alpha}$ separation decreased with increasing valency of the element. By mounting a fixed cross-wire on the plate-holder it was shown the positions of the $K_{\alpha_1}$ and $K_{\alpha_2}$ lines varied as well as the separation. This point is to receive further attention. F. S.

**1102.** *Spark-spectra of Indium and Gallium in the Extreme Ultra-violet Region.* **M. Weinberg.** (Roy. Soc., Proc. 107. pp. 138–156, Jan. 1, 1925.)—Determinations of the spark-spectra of indium and gallium in the extreme ultra-violet region were made with a special form of pyrex glass apparatus fitted with a quartz window. Gallium was contained in a small quartz cup and connected by a tungsten wire to the aluminium rod, which was used to form one electrode. A piece of aluminium wire filed to a point served as the second electrode. A Hilger quartz prism spectrograph, Type A, was used. For comparison purposes the spark spectrum of cadmium zinc lead alloy was employed. Wave-lengths were calculated from the spectrograms, which were measured by a Toepler comparator, by the Hartmann dispersion formula $\lambda = \lambda_0 + \frac{c}{n_0 - n}$ where $n$ and $n_0$ are displacements, and $\lambda_0$, $n_0$ and $c$ are constants over a small region. Eighty lines for gallium were measured, ranging from $\lambda = 1885$ to $\lambda = 2364$ Å.U., and for indium 107 lines were measured, extending from $\lambda = 1855$ to $\lambda = 2337$ Å.U. The spectrograms of the extreme ultra-violet range for gallium was very rich in lines; as many as 1000 to 1500 appeared on one plate. After eliminating the effects of impurities, 828 lines were attributed to gallium. These extended from $\lambda = 157$ Å.U. to 2059 Å.U. Indium was found to give 464 lines, ranging from 161 to 2082 Å.U. F. J. B.

**1103.** *Spark-Spectra of Tungsten and Mercury in the Extreme Ultra-violet.* **Bayen.** (Comptes Rendus, 180. pp. 57–59, Jan. 5, 1925.)—The spark was produced by means of a transformer and condenser, and tuned to resonance by Hemsalech's method. Two spectrographs were used, (*a*) a small Féry instrument giving a dispersion of 8 Å. per mm., and (*b*) a quartz instrument with Cornu prism and lenses of 1·10 m. focus, giving 2 Å. per mm. The plates were sensitised by Duclaux and Jeantet's method. Silver and copper spectra were used as comparison, assuming the values of L. and E. Bloch and Eder. Tables of wave-lengths with intensities are given for tungsten between 1873 Å. and 2065 Å., and for mercury from 1874 Å. to 2058 Å. F. S.

**1104.** *Spark Spectrum of Tungsten in the Schumann Region.* **L.** and **E. Bloch.** (Comptes Rendus, 180. pp. 133–135, Jan. 12, 1925.)—A list of wave-lengths from 1826 Å. to 1453 Å. is given. It is proposed to extend this list as far as 1873 Å., to link up with Bayen's values [see preceding Abstract]. F. S.

**1105.** *The Magnetic Spectrum of the High-Velocity $\beta$-Rays of ThB + C.* **D. K. Yovanovitch** and **J. d'Espine.** (Comptes Rendus, 180. pp. 202–203, Jan. 19, 1925.)—The authors have found the lines in the magnetic spectrum discovered by Ellis and by Meitner with good agreement up to $H\rho = 4320$ (Meitner's value); they obtain $H\rho = 5480$, where Meitner found 5460; they have also found a strong line at $H\rho = 6800$ and faint lines at 11,000 and 18,000, and a very faint one at about 40,000. Pohlmeyer, using the ionisation method, found rapid $\beta$-rays about $H\rho = 6200$, with an extreme limit of the spectrum about $H\rho = 7000$. A table gives the velocity of all the rays measured in terms of that of light, the estimated intensity, the energy in volts (about 10,000,000, for $H\rho$ about 40,000), their own values of $H\rho$ and those of Meitner. H. N. A.

**1106.** *The Zeeman-Effect with Multiplets of Higher Degree.* **A. Landé.** (Ann. d. Physik, 76. 2–3. pp. 273–283, Jan., 1925.)—In a paper by the author and W. Heisenberg [Abstract 2966 (1924)] it is shown that neon, which is the only substance in which the Zeeman-effect for a second degree spectrum has been worked out, has a singulet-triplet-triplet-quintet (1335) system. Back's analysis seems to show that in this substance the Zeeman resolution of the lines and terms does not obey the rules of Runge and Preston; but the author shows that the resolution factors $g$, which determine this resolution, form rational and constant $g$ sums, the values of which obey certain general laws. The three neon *p* terms with J = 5/2 ($p_4$, $p_6$, $p_8$, using Paschen's notation), taken singly, have irrational values of *g*, which are variable with *n*; but the sum of the three *g*'s is constant and equal to 11/3. A table gives the values of *g* or the *g* sums for the *s*, *p*, *d* and *f* terms of the simplest multiplet systems of the second degree; these are calculated by combining the branch principle and the principle of permanence of the *g* sums in passing from weak to strong fields, which Pauli has used for multiplets of the first degree. The author concludes that a simple and uniform scheme governs the structure and the Zeeman-effect of multiplets of higher degree, the meaning of which in terms of the atomic model is comprehensible in its outlines, so that consideration of the model has led to the prediction of phenomena which have afterwards been observed; the details of the scheme, however, show clearly the failure of the existing foundations of the quantum theory in the case of coupled systems. H. N. A.

**1107.** *Fine Structure in the First Lithium Spark Spectrum.* **H. Schüler.** (Ann. d. Physik, 76. 2–3. pp. 292–298, Jan., 1925.)—Three lines have been studied; the first, $Li^+$ 5485, was observed in the second order, and found to consist of eleven lines of varying intensities, which have been estimated and plotted in a diagram; $Li^+$ 3714 was observed in the third order, and resolved into two strong and one weak lines; $Li^+$ 2934 has one strong and two weaker lines. It is probable that 5485 is to be considered as $2s - 2p$; its rough structure shows identity with Paschen's infra-red helium line. It is improbable that 3714 and 2934 belong to the so-called doublet system. M. Morand calls the 5485 line $2p - 3d$, and ascribes it to a new, hitherto unknown ortholithium arc spectrum. The author has not found the next member of Morand's series, $2p - 4d$, 4244; the same is true of Morand's observations of the lines 3714 and 4814; no trace of 4814 could be found. Morand gives quite a different structure for 2934 from that observed by the author. It seems probable that the observed fine structure will be found on a reduced scale in the helium spectrum. Considering the atomic model, consisting of a positive nucleus and two electrons, it is hard to understand the complicated fine structure observed, and it seems possible that it is connected with the nuclear structure. H. N. A.

**1108.** *Primary Spark Spectra of Zinc and Cadmium.* **G. v. Salis.** (Ann. d. Physik, 76. 2–3. pp. 145–162, Jan., 1925.)—Whilst the apparatus used is briefly described, the article is largely numerical, giving detail measurements of the lines in the spectra of the above elements. B. J. L.

**1109.** *Determination of the Critical Potential of the $L_3$ Line of Argon. Discussion of its Accuracy and of the Accuracy of Similar Measurements.* **F. Holweck.** (Comptes Rendus, 180. pp. 266–268, Jan. 26, 1925.)—A homogeneous radiation was obtained by use of an anode of high atomic weight and an electron stream of low velocity from a hot kathode, this radiation being filtered *via* celluloid. The values of potential corresponding to the spectral lines are obtained by use of the absorbtion discontinuity method with an electroscope containing the gas to be investigated. This particular apparatus is described in detail. The results give a critical value of the $L_3$ potential for argon as 246·5 ± 1 volts. Corrections made to the actually observed value are described; for example, a correction for the initial velocity of electrons when first emitted from the hot kathode. The accuracy of similar methods used by other observers is questioned in this respect. B. J. L.

**1110.** *Structure of the Silver Bands* $\lambda 3330$ *and* $\lambda 3358$. **E. Bengtsson** and **E. Svensson.** (Comptes Rendus, 180. pp. 274–276, Jan. 26, 1925.)—The spectrum of silver chloride in an oxy-hydrogen blowpipe flame has been studied with a concave grating of 1·5 m. radius. The same spectrum is given more strongly by an arc in hydrogen, and has been photographed in the second order of a 6·5 m. grating. The bands can be arranged according to Deslandres' formula, and tables of wave-lengths are given. F. S.

**1111.** *Spectrum of Carbon Monoxide at Very Low Pressure.* **F. Baldet.** (Comptes Rendus, 180. pp. 271–273, Jan. 26, 1925.)—The method of exciting the spectrum was as previously described [see Abstract 1877 (1924)]. There are thirty bands between $\lambda = 5700$ and $\lambda = 3080$, each having four heads degraded towards the red. Tables are given of the wave-lengths of these band heads and their wave-numbers. The similarity of this spectrum to that of the third group of air is pointed out, and it is suggested that the oxygen atom plays a preponderating part in both. F. S.

**1112.** *On the Mercury Line* 2270 Å. ($1S - 2p_1$). **T. Takamine** and **M. Fukuda.** (Phys. Rev. 25. pp. 23–29, Jan., 1925.)—In a previous experiment by Hansen, Takamine and Werner the line $\lambda 2270$ ($1S - 2p_1$) was found to be excited either in a condensed discharge or in a strong magnetic field. By using the method employed by Metcalfe and Venkatesachar for the study of the absorption of mercury lines, it was found that the glow in the branched arc of a special kind of mercury lamp emits this line with considerable intensity. Under best circumstances, its intensity was stronger than the arc line 2302 ($2p_2 - 9d_2$), but fainter than 2323 ($2p_2 - 8d_2$). When analysed by a large Hilger quartz spectograph of the Littrow type, it was found that in a heavy condensed discharge the lines 2270 ($1S - 2p_1$) and 2345 ($2p_3 - 5s$) are shifted about 0·1 Å. towards the red, whereas the line 2564 ($2p_2 - 4S$) is displaced about 0·1 Å. towards shorter wave-lengths relative to their positions in an ordinary arc spectrum. AUTHORS.

**1113.** *A New Shielded X-Ray Tube.* **Fauconnier.** (Elettrotecnica, 11. pp. 977–978, Dec. 15, 1924.)—This new tube, known as the Philips-Metalix, concentrates the radiation into a conical beam, and so protects the operator. It consists essentially of a long metal tube, through an opening in one end of which the X-rays emerge after passing across the glass portion of the tube. The incandescent filament, of circular shape and connected at one extremity to the metal of the apparatus, faces this opening. The tungsten mirror, which forms the anti-kathode, is at right angles to the tube axis and closes a long metal cooling-tube containing water. The water for cooling is, however, not in direct contact with the mirror, but is separated from it by a copper vessel containing a small quantity of water under a pressure of a few millimetres of mercury. The tube is made in two sizes, the one for 15,000 volts and 15 milliamperes, and the other for 70,000 volts and 50 milliamperes. A new type for 200,000 volts is under investigation. E. B.

**1114.** *The Level Values of the X-Ray Spectra of the Chemical Elements.* **B. Walter.** (Zeits. f. Physik, 30. 6. pp. 357–371, 1924.)—Bohr and Coster have determined the $\nu/R$ values of the different levels for a number of elements, and plotted the square roots of these values against the atomic numbers [Abstract 1398 (1923)]. The author develops a method for finding the level values for atomic numbers from 20 to 50 with considerably greater accuracy; this depends on a determination of the wave-length of the K absorption limit for each element, from which the values for the other levels are deduced, in the usual manner, by subtraction or addition of the energy values of the emission lines belonging to them. The wave-length of an absorption limit cannot be determined with anything like the same accuracy as that of an emission line, but the author investigates the relation between the wave-length of the absorption limit and that of the $K\gamma$ line of the same element, the two lying close together. Chief reliance is placed on determinations of this relation by Duane and Hu for Rh, by Duane and Stenström for W, and by the author using the value of Siegbahn and Dolejsek for the $K\gamma$ line in the case of Ni. The percentage differences $p$ of these wave-lengths are 0·06 for Ni, 0·23 for Rh, and 0·53 for W; and if these are plotted against the atomic numbers the three points lie on a straight line, which cuts the axis at about $N = 22$ instead of at $N = 18$, as might be expected from the theory. It is shown, however, that small variations of this graph have little influence when it is used to determine the values of $\lambda_A$, the K absorption limit for the elements in question; these are given in a table for all atomic numbers except 31, 33, 36, 43 and 44, from 22 Ti to 52 Te. The values of $\nu/R$ and of $\sqrt{\nu/R}$ are tabulated for all the different layers of these elements, and the $\nu/R$ values for the $M_{III}$ level, as given by Bohr and Coster for atomic numbers 22 to 30, are tabulated against the author's values; the first are distributed very irregularly, increasing on the whole, but sometimes diminishing as the atomic number increases, while the second show a fairly regular increase. This becomes very evident when $\sqrt{\nu/R}$ is plotted against N, the points lying along a straight line from 22 to 29, and along another straight line with steeper slope from 29 to 52. Similar breaks at 29 were found for the $L_{II}$ and $L_{III}$ levels, agreeing with Bohr and Coster. The breaks found by them at 39 and 46 do not appear in the graphs obtained.

H. N. A.

**1115.** *The Theory of X-Ray Scattering.* **O. Halpern.** (Zeits. f. Physik, 30. 2. pp. 153–172, 1924.)—It has been shown recently that the scattered X-radiation from a body may have a different frequency from that of the incident radiation, the alteration in frequency increasing with the angle between the incident radiation and the direction of observation. The intensity of radiation is larger in the direction of their incident rays. The phenomena increase in importance the harder the rays. The experimental results of various observers are not in complete accordance. The paper is mathematical throughout, and consists of an attempt to obtain theoretically a Compton-effect on the basis of classical electromagnetic theory. After a general introduction calculations are made on the motion of an electron under the influence of a plane linearly polarised wave (travelling along the axis of $z$) using relativistic mechanics and neglecting the damping due to radiation. Forming the Lagrange functions and integrating by the device of transforming to a coordinate system moving with the velocity of light in the direction of the radiation, it is shown that the electron has a translational velocity in the $x$ direction and also in the $z$ direction, the former vanishing when integrated over all phases. Using classical mechanics and considering the effects of radiation damping, the author obtains a translational velocity in the direction of the radiation, the uniform velocity being determined by the intensity of radiation sent out. The results show a formal analogy to the Compton equations. Thus the results are established that the scattering of rays and electrons on the classical theory produces effects of a type usually asserted to be due to quantum considerations. W. V. M.

**1116.** *The J Transformation of Scattered X-Rays.* **C. G. Barkla** and **S. R. Khastgir.** (Phil. Mag. 49. pp. 251–256, Jan., 1925.)—An experiment is described which is intended to show that, when X-rays are scattered by passing through a thin sheet of paper, the secondary radiation is originally exactly like the primary in penetrating power, but that when the primary and secondary radiations are transmitted through equal thin sheets of aluminium this equality of penetrating power persists only up to a certain critical thickness of absorbing material, when an abrupt absorption of the secondary radiation occurs, the transmitted radiation being subsequently more absorbable than the primary. Similar discontinuities have been obtained by filtering the radiations by paper and by copper. This is assumed to indicate that the original truly scattered rays are converted into a different kind of ray, to which the name J-ray has been given, by passing through a certain thickness of absorbing material. The J process is probably governed by quantum laws, but it is quite distinct from the process of scattering. H. N. A.

**1117.** *Smectic Substances and X-rays.* **E. Friedel.** (Comptes Rendus, 180. pp. 269–271, Jan. 26, 1925.)—In a former paper de Broglie and the author [see Abstract 1397 (1923)] have shown that the oleates of sodium, potassium and ammonium in the smectic state give radiograms showing X-ray diffraction. Certain other investigators [McBain, Nature, 113, p. 534, April 12, 1924] have asserted that purely smectic bodies do not diffract X-rays, and suggest that the results of de Broglie and the author are due to the presence of the oleates in the crystalline state. The author now gives further evidence in support of his previous contention, giving the results obtained with typical smectic substances, azoxybenzoate of ethyl and azoxycinnamate of ethyl. These two substances and their mixtures crystallise at ordinary temperatures, but pass into the smectic state on heating to a certain temperature, $T_1$, whilst at a temperature higher still, $T_2$, they become amorphous. These three states are demonstrated by X-ray diffraction observations. In the smectic state, between $T_1$ and $T_2$, the equidistant atomic planes set themselves all in the same direction—a characteristic of the smectic state. A. B. W.

**1118.** *Diagrams of Laue obtained by Means of Monochromatic X-rays and the Structure of Mother of Pearl.* **J. H. Shaxby.** (Comptes Rendus, 179. pp. 1602–1603, Dec. 29, 1924.)—The method of obtaining the diagrams of Laue is briefly described. An examination of the structure of mother of pearl shows that when the rays are propagated normally to the thin layers six diffuse spots appear, indicating a quasi-hexagonal symmetry of the atoms in the planes of stratification. In the direction parallel to these planes a diagram is obtained which indicates a rectangular arrangement. The mineral constituent of the mother of pearl is aragonite, the structure of which has been studied by Huggins and experimentally by Bragg [see Abstract 1068 (1924)]. The latter has classed aragonite as holosymmetric of the orthorhombic system, with fundamental axes *a*, *b*, *c*, measuring 4·94 Å., 7·94 Å. and 5·72 Å.; *c* is the axis of pseudo-hexagonal symmetry, and the unit of structure contains 4($CaCO_3$). Huggins [Abstract 1843 (1922)] found an arrangement quite different for the $CO_3$ groups relative to the atoms of Ca and a smaller unit of structure containing only 2($CaCO_3$). The measurements made by the author entirely confirm those of Bragg. He claims to have shown that the mineral part of mother of pearl consists of crystals of aragonite, of which the quasi-hexagonal axis is normal to the thin layers. A. E. G.

**1119.** *X-Rays of Great Wave-length.* **A. Nodon.** (Comptes Rendus, 179. pp. 1600–1601, Dec. 29, 1924.)—In this communication the author is trying to establish a claim to the discovery of X-rays of great wave-length between $\lambda = 750$ Å. and $\lambda = 12$ Å. In a note published in 1901 the following facts were given: The experiment has shown that X-rays can be produced in air and outside the vacuum of Crookes; these X-rays come into existence under the simultaneous influence of ultra-violet rays and an electric field. The activity of the X-rays emitted is a function of the intensity of the electric field, of the intensity of the ultra-violet radiations, of the length of the ultra-violet waves, and of the nature of the substances at the surface of which they are generated. In another note, 1902, it was pointed out that when the luminous radiations or ultra-violet rays are projected upon a thin conducting layer they generate upon the non-illumined face of this layer radiations analogous to X-rays. The first measurements which were made upon their wave-length by Dember was not until 1923. [See Abstract 1642 (1901).] A. E. G.

**1120.** *Abnormal Reflection of X-Rays.* **J. H. Smith.** (Phil. Mag. 49. pp. 192–194, Jan., 1925.)—A brief discussion arising out of an observation by Clarke and Duane [Abstract 2202 (1923)] that certain X-ray diffraction maxima do not obey the two laws governing the Bragg maxima—namely, the angle of incidence equals the angle of reflection, and that the orders of spectra are given by $n\lambda = 2d \sin \theta$. The abnormal maxima are ascribed to the effect of periodicity of scattering centres in the atom planes themselves, and, unlike the Bragg maxima, the positions of the abnormal sets will vary as the crystal is rotated about the normals to the planes producing them. A. B. W.

**1121.** *On the Measurements of X-Ray Intensity by Ionisation Methods.* **L. H. Clark.** (Brit. J. of Radiology, 21. pp. 21–27; Disc., 27–28, Jan., 1925.)—Errors occur in ionoquantimetric measurements due to the secondary radiation from the ionisation chamber walls. These are avoided by the use of an air-gap ionisation method, but it is still necessary to determine the relation between ionisation and wave-length. Experimental apparatus to determine this relation is described in detail. A method is developed in which an air-gap intensimeter is adopted for use for different wave-length radiations by means of a change in total capacity of the electroscope, and a theoretical relation $c_1/c_2 = 1 - \epsilon^{-Kn_1^3x}/1 - \epsilon^{-Kn_2^3x}$ is obtained, where $n_1$ and $n_2$ are dependent upon the X-ray beam and particular filter used. To simplify such calculations the use of three or four standard spectral ranges is suggested. A discussion followed, from which it appeared this method had been used between 100–150 kv., but not for voltages used in deep therapy. B. J. L.

**1122.** *X-Ray Emission from Metal Films.* **L. Simons.** (Phys. Soc., Proc. 37. pp. 58–70; Disc., 70–71, Dec., 1924.)—It is well established theoretically and experimentally that the kinetic energy of emission of electrons from a substance exposed to X-rays may be

$$(1/2 \, . \, mv^2)_{\text{K.L.M., etc.}} = h\nu - h\nu_{\text{K.L.M. etc.}}$$

where $h\nu$ is the energy of the incident quantum and $h\nu_{\text{K.L.M., etc.}}$, is the energy associated with one of the quantum absorption limits of the substance. As the K quantum limit has greater energy than the L.M., etc., limits, it follows that the K $\beta$-rays should have the smallest energy. Hence arises the difficulty in giving a quantitative explanation of the selective increase in ionisation by collision and absorption when $\nu$ exceeds $\nu_K$. The problem has been approached experimentally by Barkla and Dallas [Abstract 874 (1924)], who have shown how the total energy of the $\beta$-rays from silver varies with the wave-length as the region of the K limit is crossed. The author has now determined directly the aggregate number of $\beta$-rays of all types emitted over the same range, and shows thereby that no selective change in the average energy occurs when the K fluorescent spectrum is excited. It is suggested that this result is brought about by a re-grouping amongst the numbers and energies of the $\beta$-ray constituents, together with the addition of the K group of minimum individual energy as is required by the above equation. The experimental work has necessitated the separation of the $\beta$-rays from the secondary effects they produce, the chief of which is due to the production of $\delta$-rays of very low energy. The method of this separation is dealt with, and the origin of the $\delta$-rays discussed from the points of view of (*a*) thermionics, (*b*) recoil electrons, (*c*) impact electrons. The $\delta$-rays are electrons whose most frequent energy is little greater than 3·5 volts, which seems to be independent of the wave-length producing them and of the substance from which they come. There are indications that they are influenced, at the moment of their departure from the surface, by the scattered X-rays. A. B. W.

## RADIO-ACTIVITY.

**1123.** *Colouration and Luminescence produced by Becquerel Rays.* **K. Przibram.** (Phys. Zeits. 25. pp. 640–642; Disc., 642–643, Dec. 1, 1924. Paper read before the Deut. Naturforscher u. Ärzte, Innsbruck, 1924.)—Further new results [Abstract 882 (1924)] are now given. Preliminary treatment of kunzite with Becquerel rays increases the intensity of the luminescence following subsequent exposure to $\gamma$-radiation. The increase in brightness is more rapid if the interval between the two irradiations is diminished, but the same limiting value is always reached. Certain English fluorites exhibit a momentary radio-luminescence of the character of a fluorescence, the non-fluorescence or blue fluorescence observed in ordinary light changing to a bright red fluorescence after exposure of the crystals to Becquerel rays. A similar phenomenon is encountered with drusy masses of intergrown rock-salt and sylvine crystals from Stassfurt. With kunzite the total light producible by heating attains a saturation value, on increasing exposure to $\gamma$-rays in the same time as the colouration measured by the absorption coefficients. This also occurs with certain specimens of rock-salt. These show also in marked degree the well-known fatigue phenomenon, the intensity of the luminescence falling to one-half in a few hours on exposure to 30 mg. of radium placed at a distance of 2 mm. from the axis of the crystal. The subsequent alteration is only slow. T. H. P.

**1124.** *Secondary $\beta$-rays produced in a Gas by X-rays.* **P. Auger.** (Comptes Rendus, 180. pp. 65–68, Jan. 5, 1925.)—In a former note [see Abstract 2449 (1923)] the author has described and interpreted the main features presented by the secondary $\beta$-rays, studied by C. T. R. Wilson's method, when they are produced by X-rays in an atmosphere of hydrogen containing a small proportion of a heavier gas. Further experiments, in particular using krypton, have confirmed the author's views and lead to certain conclusions, to which reference is made in the present paper. A. B. W.

**1125.** *Absorption of Radiation by an Atom in the State of Emission.* **M. de Broglie** and **J. Thibaud.** (Comptes Rendus, 180. pp. 179–180, Jan. 19, 1925.)—In a recent paper Auger [see preceding Abstract] has drawn attention to the intense absorption which takes place inside an atom which is in process of emitting radiation. The possible causes and consequences of such an effect are considered. "It is the atom which emits $\gamma$-rays which has the greatest probability of absorbing these rays and of converting them into photoelectrons." This is the authors' conclusion, which is supported by similar views expressed by Ellis. [See Abstract 1782 (1921).] A. B. W.

**1126.** *Absorption of $\beta$-rays by Matter.* **G. Fournier.** (Comptes Rendus, 180. pp. 284–287, Jan. 26, 1925.)—The experimental results obtained by means of the $\beta$-radiation from a source of RaD + E give support to the law $\mu/\rho = a + b\text{N}$, where $\mu$ = absorption coefficient, $\rho$ density, N atomic number, and $a$ and $b$ constants. C, Al, Cu, Mo, Ag and Sn were used as absorbers of the $\beta$-rays. It is proposed to continue the experiments with other groups of $\beta$-rays. A. B. W.

**1127.** *Research on Characteristic $\gamma$-Ray Spectra by Crystalline Diffraction.* **J. Thibaud.** (Comptes Rendus, 180. pp. 138–140, Jan. 12, 1925.)—As shown in previous papers [Abstracts 379 and 882 (1925)], it is possible to study the various monochromatic frequencies of a complex $\gamma$-radiation by conversion of this radiation by photoelectric effects into $\beta$-ray spectra and measuring the energies of the various electronic streams emitted. The method of crystalline diffraction may be used for $\gamma$-rays to give their wave-lengths by a more direct method. Hitherto the smallness of the angle of reflection has limited the measurements to a quantum of 170,000 volts [Rutherford and Andrade, Abstract 185 (1915)]. The author has employed the rotating crystal method and photographic registration. A wave-length $\lambda$ being reflected when $\sin \alpha = n\lambda/2d$, for the $\gamma$-rays employed $\alpha$ is not greater than a fraction of a degree. A fine slit of $\gamma$-rays fell on to a crystal of rock-salt carried on a gonometer and rotating with an angular velocity of less than 1° in 24 hours. The dispersion was fairly large, as the distance from the crystal to plate was 45 to 65 cm., and the exposure required was 40 to 200 hours. The sources of $\gamma$-radiation employed were 40 mg. of Ra Bromide (RaB + C) in equilibrium, a preparation of mesothorium with a total activity equivalent to that of 15 mg. of $RaBr_2$, and also 49 millicuries of radiothorium. The $\gamma$-rays obtained were fine line-spectra without any appearance of continuous bands. The following rays were observed from the tube of radiothorium :—

| Nos. | λ in A°. | Energy (volts). | Origin. |
|---|---|---|---|
| 1 | 0·168 | 73,500 | ,, |
| 2 | 0·145 | 85,000 | RdTh |
| 3 | 0·062 | 198,600 | ,, |
| 4 | 0·052 | 236,000 | ThB |

The spectra obtained with Ra confirm the two rays observed by Rutherford near 1° 30′. The $\beta$-ray spectra of lead when exposed to the same radiation was studied, and by this indirect method the presence of a ray having an energy of 233,300 was detected, confirming the previous result. This same ray has been obtained by Meitner and also Ellis. W. V. M.

**1128.** *Measurement of the Radio-active Disintegration Products in the Atmosphere from an Aeroplane.* **H. Bongards.** (Phys. Zeits. 25. pp. 679–682, Dec. 15, 1924. Paper read before the Deut. Naturforscher u. Ärzte, Innsbruck, 1924.)—A definite amount of air was driven through a cylindrical condenser, consisting of a tube 12 cm. in diameter, divided into three parts, 40, 40 and 80 cm. long, in the axis of which was a wire connected to the positive pole of a high-tension arrangement, while the cylinder could be connected to the negative pole. A small circular fan with a counter at one end of the cylinder could be started and stopped by the aviator when the aeroplane was travelling at a given height, and drove air through the tube. Positively charged particles—of RaA, for example—were deposited on the walls of the cylinder, which on landing was placed on the plate of a bifilar electrometer, and, with a suitable cover, formed an ionisation chamber, by means of which the amount of the radio-active deposit could be measured. Twenty-six flights were made from July to Sept., 1924, during which months measurements were also made by the Smithsonian Institution in Washington, and the author gives some preliminary results obtained from the German observations. For eleven flights there are two distinct groups, in one of which the activity is from one-tenth to one-hundredth of that which has been found by a number of experimenters near the ground; after Sept. 1st, on the other hand, values are obtained similar to those observed near the surface. There appears to be some indication that the air temperature increases with the activity, and this is regarded as pointing to a radiation from outside the earth's atmosphere. Some of the decay curves obtained point to the presence of thorium products. Thorium emanation has a mean life of only 79 seconds, so that it is impossible that it should be able to diffuse from the earth at the height of 3000 m., at which the experiments were carried out; and if thorium products are really present, it seems clear that they have entered the atmosphere from above. H. N. A.

**1129.** *The Composition of Bröggerite and the Genetic Connection between Thorium and Uranium.* **W. Riss.** (Akad. Wiss. Wien, Ber. 133. 2a. No. 3–4. pp. 91–100, 1924.)—Continues the investigation of G. Kirsch, who has concluded from analyses of uranium minerals, in which the ratio of lead to uranium and thorium to uranium was determined, that there is a genetic connection between thorium and uranium [see Abstract 1194 (1924)]. A very large amount of material has been analysed, the methods of analysis being described. The results are plotted, Pb/U against Th/U, and at first sight there does not appear to be any regularity; but if it is assumed that some of the ores originally contained a quantity of lead approximating closely to 0·6 %, while others contained little or none of this substance, it becomes possible to draw two nearly equidistant curves, about which the observations group themselves fairly satisfactorily, though the agreement with the above theory is not as good as Kirsch obtained with his comparatively few observations. On the whole, however, the new results agree quite well with the assumption that thorium is a product of uranium, and there is evidence in the diagram that there was no thorium originally in the crystals analysed. When crystals from a single pegmatite load are considered it is found that the relations between Pb/U and Th/U are often very different, indicating that the ages of the crystals vary greatly, and it is suggested that some of them were formed in the magma long before the formation of the lodes, while others were formed much later; apparently the latter are generally more brittle than the former, and it may be possible to use them in determining the age of the lode. H. N. A.

**1130.** *Observation of High-Altitude Radiation at Sea-Level.* **G. Hoffmann.** (Phys. Zeits. 26. pp. 40–43, Jan. 1, 1925.)—Referring to Kolhörster's observation of a very penetrating radiation (ten times harder than γ rays) on Alpine glaciers [Abstract 1098 (1924)], the author applied his apparatus for reducing the effect of the radiation from the walls of the ionisation chamber [Abstract 2531 (1924)] to observations at sea-level. In the chamber, which is filled with $CO_2$ at 1300 mm. of mercury, he mounts three wire rings, 8 cm. in diameter, at right angles to one another to form a very open cage charged to 500 volts. Photographic records of the electrometer needle movements are obtained. The number of ions being reduced to three or five per hour, the curves practically record the more γ penetrating rays. The residual current of 4·7 J (reduced to air at 760 mm.) was diminished to 1·56 J when the chamber was provided with a lead sheath 3 cm. in thickness. A sheath of 12 cm. reduced γ-rays to 1 % of their intensity, but should reduce Kolhörster's ten times harder radiation, supposed to be of cosmic origin, only by 40 %. The curves obtained did not show any diurnal variation. The lead sheath is further to be thickened. H. B.

**1131.** *Proportion of Radium in Uranium Minerals which Contain Tantalum, Niobium and Titanium.* **(Mme.) P. Curie.** (Comptes Rendus, 180. pp. 208–211, Jan. 19, 1925.)—The methods employed at the Radium Institute for the extraction of radium from uranium minerals and its determination from the emanation given off are described in detail. The relative advantages of fusing the sample, or dissolving the whole sample, or only the radio-active part, are discussed for such minerals as euxinite, betafite, and autunite. R. S. R.

## HEAT.

**1132.** *The Thermal Conductivity of Solid Electric Insulators. II.* **W. M. Thornton.** (Phil. Mag. 48. pp. 1054–1056, Dec., 1924.)—For many electrical insulators it has been shown by the author that the thermal conductivity $k = \mathrm{E} . \rho . 10^{-14}$ for widely different substances [see Abstract 393 (1920)], where E is the longitudinal elasticity and $\rho$ the density. Expressing the heat $k$ as $\frac{mv^2}{\mathrm{J}}$, $v$ is the difference of the mean square velocities of vibration between opposite sides of unit cube across which unit temperature gradient is maintained. Hence $k = \mathrm{E}\rho = \rho v^2/\mathrm{J}$, as the mass of the unit cube $= \rho$. The velocity of molecular heat vibration thus follows the same law as that of sound in that $v^2$ varies as the longitudinal elasticity. This is the meaning, then, of the relation between $k$, E, and $\rho$, given in the previous paper. The case of graphite is taken as illustration, and it is shown that at temperatures approaching the infra-red, with atomic frequencies about $10^{12}$, the corresponding change of amplitude, $10^{-10}$ cm., is a not improbable value for atomic vibrations. Reference is made to some apparent exceptions to the equation in the case of certain glasses, as pointed out by J. R. Clarke [Abstract 268 (1921)], and a possible explanation of the anomaly is given. T. B.

**1133.** *A Note on the Conduction of Heat Down the Necks of Metal Vacuum Vessels containing Liquid Oxygen.* **G. R. D. Hogg.** (Faraday Soc., Trans. 20. pp. 327–336, Dec., 1924.)—The heat which enters cold liquids stored in vacuum vessels is transferred by (1) conduction through the residual gas in the vacuum space; (2) radiation across the vacuum space; (3) conduction down the walls of the inner neck [see Abstract 1172 (1923)]. No calculations have hitherto been made on the heat entry down the neck, and available experimental data are meagre. This paper is an attempt to provide methods for calculating the amount of heat entering a vacuum vessel by the neck, and formulæ are given from which the most convenient dimensions for the neck of a given vessel may be determined. If $m$ is the total mass of gas evaporated per second, and $m_0$ the mass evaporated by heat entering from the neck, the values of $m_0$ found by different assumptions are :—

$$m_0 = m\sigma(\theta_0 - \theta_1)/\mathrm{L}\left(e^{\frac{\sigma ml}{ac}} - 1\right) \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$m_0 = (\sigma m\theta_1 - \mathrm{P})/\mathrm{L} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$m_0 = (\sigma m/\mathrm{L}) . (\theta_1' - \mathrm{F}) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where $\sigma$ = specific heat of gas; $\theta_0$ = abs. temp. of air, $\theta_1$ = that of the liquid; L = latent heat of vaporisation of liquid; $l$ = length of neck; $a$ = cross-sectional area of metal of neck; $c$ = its thermal conductivity; and F and P are constants.

These formulæ have been applied to two vessels of the types described in the Report of the Oxygen Research Committee, a small vessel or vaporiser, and a larger vessel or container. The ratio of neck loss to total loss comes out as 20 % to 30 % for the vaporiser, but only about

2 or 3 % for the container. The effect of shortening or otherwise varying the dimensions of the neck is also considered. T. B.

**1134.** *Cause of the Splitting of the Tubes in Vacuum Evaporators.* **B. Neumann** and **E. Zöllner.** (Zeits. Elektrochem. 31. pp. 24–31, Jan., 1925.)—In evaporating caustic soda or caustic alumina in a vacuum distilling apparatus it frequently happens that the cast-iron tubes split without any apparent cause, the fracture generally occurring at or close to the place where they are built into the boiler. This is usually attributed by chemists to defects in the metal, whereas the makers of the apparatus put it down to the action of the lye. The authors examined a number of split and new tubes from various factories, and their investigations led to the conclusion that the splitting is due neither to chemical attack nor to undue mechanical strain, but to a deformation of the material where the tubes are fitted in, which deformation may be excessive owing to improper application of the rolling tool. This is why sooner or later the temperatures of evaporation so increase the brittleness of the material at these points that "blue fracture" occurs. To diminish this risk care should be taken to adjust the diameter of the tube as accurately as possible to the aperture which is to receive it, so that it may be tightened up with a minimum of deformation. It is also most important that the application of the rolling tool be absolutely central, so as to avoid irregular deformation. E. F.

**1135.** *Annealing and Re-Annealing of Glass.* **W. M. Hampton.** (Optical Soc., Trans. 26. 1. pp. 14–28; Disc., 29–30, 1924–1925.)—Important factors in the annealing of glass are discussed. Relations connecting the strains present when cooling commences, strain due to gradient and strain present after cooling are obtained, and the equations are applied to the case of slabs. Tables are given showing for different slabs the fraction of temporary strain remaining as permanent. Considerations of temperature and effects of pyrometor errors are discussed. E. H. B.

**1136.** *Theory of Resistance Thermometers.* **J. Friese** and **E. Waetzmann.** (Zeits. f. Physik, 31. 1–4. pp. 50–59, 1925.)—The paper deals with a mathematical discussion of resistance thermometers, and is not suitable for abstracting. F. J. B.

**1137.** *Optical Pyrometers.* **W. E. Forsythe.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 19–37, Jan., 1925.)—This is a report giving a summary of the methods employed in optical pyrometry. The various types of instruments are considered, and special attention is devoted to the spectral transmission characteristics of the different screens which may be used in these instruments. There is also a short account of the methods of calibration based upon the radiation laws. A. A. D.

**1138.** *Some Applications of Thermo-Elements in the Measurement Technique of the Heavy Chemical Industry.* **P. Gmelin.** (Ann. d. Physik, 76. 2–3. pp. 198–224, Jan., 1925.)—This paper contains in Part I. the description of a measuring principle with three modes of application for the technical evaluation of the oxygen content in hydrogen, nitrogen, and mixtures of hydrogen and nitrogen. The apparatus described, which is provided with registration and alarm indicators, brings about reaction by means of a platinum catalyst, this being recorded by a thermo-element connected with a millivoltmeter. Very full details of the utility of this apparatus are given, with numerous examples. Part II. describes a technical rapid recorder of the calorific values of gas mixtures, based on the use of sensitive thermo-elements placed in the emitted radiation from a burning gas mixture. Details for obtaining maximum sensitiveness are included. Diagrams for generator gas are provided as examples of the practical utility of the apparatus. The whole paper abounds in serviceable data and illustration. H. H. Ho.

**1139.** *Note on Vapour Pressures of Monatomic Substances.* **A. C. Egerton.** (Phil. Mag. 48. pp. 1048–1054, Dec., 1924.)—On the basis of the thermodynamic vapour-pressure formula a linear equation $\log p = -\frac{a}{T} + b$ closely represents the variation of vapour pressures with temperature of a solid with monatomic vapour. Various examples are given of the application of this equation. A vapour-pressure determination at a single temperature should suffice to determine the course of the whole curve. AUTHOR.

**1140.** *Saturated Vapour Pressure of Hydrocyanic Acid.* **R. Hara** and **H. Sinozaki.** (Tôhoku Univ. Technol. Reports, 4. 3. pp. 35–42, 1924. In English.)—Determinations of the vapour pressures of hydrogen cyanide at temperatures between 0° and 46° give results which agree, to within 0·1 to 0·3 %, with the expression $\log P = -\frac{1836\cdot63}{T^{1\cdot05}} + 7\cdot5030$, where P is the pressure in mm. and T the absolute temperature. The boiling-point of hydrogen cyanide at 760 mm. pressure is found to be 25·7° and not 26·5°, as is usually stated. T. H. P.

**1141.** *Vapour Pressure of Tellurium.* **J. J. Doolan** and **J. R. Partington.** (Faraday Soc., Trans. 20. pp. 342–344, Dec., 1924.)—The method used for measuring the vapour pressure of tellurium consisted in passing a measured quantity of nitrogen in a steady stream over the heated element, the loss in weight being obtained at three fixed temperatures and at least three rates of flow employed at each temperature. From the relation (mols. of vapour) : (mols. of vapour + mols. of gas), the pressure of the element is found for each rate of flow, so that the rate at zero flow may be deduced. At 671°, 578°, and 488° C. the vapour pressures are $1\cdot86 \times 10^{-2}$, $4\cdot40 \times 10^{-3}$ and $6\cdot10 \times 10^{-4}$ atmos. respectively. The latent heat of vaporisation is approximately 26·5 cals. per gramme-mol. T. H. P.

**1142.** *On the Thermodynamic Foundations of the Theory of Thermic Radiation.* **P. Straneo.** (N. Cimento, 1. pp. 345–357, Oct.–Nov.–Dec., 1924.)—A sequel to the note in Accad. Lincei, Atti, 31. i. p. 24, Jan., 1922, discussing A. Bartoli's contribution to the question of the thermodynamic prevision of the pressure of light. The present paper is mainly mathematical and leads to the conclusion that the law discovered by Bartoli is not that which is generally attributed to him, namely the law of the existence of the pressure of light. It is a wider law, almost independent of any special optical theory, and is narrowed down to that of the pressure of light only as a result of successive particularisations. It is, further, important to note that whereas Bartoli's law follows from thermodynamic considerations only with the optical admission of the finite velocity of the propagation of radiation, the law of the pressure of light demands the admission of the electromagnetic theory or, in the case of corpuscular radiation, some other well-defined mechanical admission.

E. F.

**1143.** *The Study of Specific Heats.* **S. Wiesner.** (Ann. d. Physik, 76. 4. pp. 439–443, Feb., 1925.)—The paper recalls the deviation from Dulong and Petit's law of bodies having low atomic weights and atomic volumes. It is pointed out that the greatest anomaly occurs in the case of specific heats at the point of transition from solid to liquid. The author works out an expression of simple character for this variation and supports it by application to known experimentally obtained values. A detailed theoretical proof is given, and the practical illustrations are finally embodied in a table of results for nine different bodies. S. G. B.

**1144.** *Temperature Gradient in Gases at Various Pressures.* **W. Mandell** and **J. West.** (Phys. Soc., Proc. 37. pp. 20–40; Disc., 40–41, Dec., 1924.)—A careful re-examination of the problem of the temperature gradients through gases at various pressures is here carried out. Previous workers in this field include Kundt and Warburg (1875), Smoluchowski (1898), Knudsen (1911), Gehrcke (1900), and Lasareff (1912). Sets of curves indicating these gradients at various pressures and other interesting relations are obtained. Amongst other features, they show quite definitely the existence of very large temperature jumps between the vessel walls and the *low-pressure* gas in contact with them. These jumps in one set of experiments varied from 23° to 43° C. for contact with the cold wall at 49° C., and from 36° to 64° C. for contact with the hot wall at 173·7° C. Thus, in one case, of the total fall of temperature 124·7° C. between the hot and cold walls, only a fall of 17·2° C. occurred in the gas occupying the space between these walls, the remaining fall occurring in the two jumps referred to above. An attempt to explain the general character of the results is based on the assumption of the presence at the walls of a gas film possessing certain properties due to the attracting forces existing among wall molecules and gas molecules. The paper is illustrated by diagrams of the apparatus, etc., and a number of graphs.

E. H. B.

**1145.** *Ignition of Gases. Part V. Ignition by Inductance Sparks of Paraffin-Air Mixtures.* **R. V. Wheeler.** (Chem. Soc., J. 127. pp. 14–26, Jan., 1925.)—The inductance sparks (break-flashes or momentary arcs) are produced by the separation of metallic contacts in inductive circuits. Experiments on the lowest current capable of igniting mixtures of methane and air of varying concentrations by a succession of inductance sparks of varying inductance at 90, 60, 30 volts all gave similar **U** curves, but showed that the incendivity does not merely depend upon $\frac{1}{2}Li^2$. The nature of the electrode metal and several factors come into play. Volatile metals (Cd and Zn) give more sustained flashes than platinum; with oxidisable metals the effective contact changes even during the experiment and is difficult to determine. For rapid ignition the battery volts should be low and the inductance fairly high, so that the spark is maintained primarily by the inductance volts; the metal should not be oxidisable, the actual area of contact small, and the rate of separating the contacts rapid. On the whole, so far as paraffin hydrocarbons are concerned, there is not much difference between capacity sparks and inductance sparks. Thornton had observed that larger ignition currents are required on a.c. than on d.c. circuits. The author finds that ignition is more difficult with a.c., but that there is little difference in the intensity. H. B.

**1146.** *On the Isotherms of Helium, Nitrogen, and Argon below* 0°. **L. Holborn** and **J. Otto.** (Zeits. f. Physik, 30. 4–5. pp. 320–328, 1924. From the Reichsanstalt.)—Previous measurements [see Abstract 1849 (1924)] have been made for temperatures from 0 to 400°. The results now recorded have been compiled below 0°. Experimental details with data tables are included. From this more comprehensive data formulæ are derived for the correction of gas thermometers (employing helium, nitrogen, and argon) on the thermo-dynamic scale up to + 400°. In the region of small pressures these formulæ lead to simple equations of state. H. H. Ho.

**1147.** *On the Influence of Cooling a Gas Prior to Compression.* **G. Patart.** (Comptes Rendus, 180. pp. 120–122, Jan. 12, 1925.)—This compression problem is considered first in the absence of, and then after, previous cooling, and a comparison is given of the amounts of energy consumed in the two cases. The optimum cooling temperature is then deduced. The geometrical study of compression and cooling diagrams leads to the same conclusion as the analytical—*viz.* that prior cooling to the optimum temperature affords the same energy result as compression in two stages with an intermediate period at the most favourable pressure. This result is important for industrial compression processes where economy may be effected in the number of operations. H. H. Ho.

**1148.** *A Note on the Connection between the Specific Heat* $C_v$, *the Internal Energy U and the Equation of State of a Body based on the Second Law of Thermodynamics.* **H. Hausen.** (Zeits. f. Physik, 30. 4–5. pp. 277–279, 1924.)—This paper is a reply to a publication by Jazyna [see Abstract 2291 (1924)], and shows that his derivation of a so-called reciprocal theorem, whereby the van der Waals' equation of state stands in contradiction with the second law of thermodynamics, is incomplete and can therefore not be regarded as valid. H. H. Ho.

**1149.** *On the Proof and Basis of the Reciprocal Theorem.* **W. Jazyna.** (Zeits. f. Physik, 30. 6. pp. 372–375, 1924.)—This paper is supplementary and explanatory to one previously published [see Abstract 2291 (1924)]. § 1 deals entirely with reversible processes and corresponding equilibrium states. The condition that the contours of the surfaces in the *pv*- and ST-diagrams should form cyclic processes is necessary but not sufficient for the equivalence of these surfaces. In § 2 it is shown to be probable that for T = 0 the body is either absolutely incompressible (the so-called "quasi-permanent" equilibrium in the condensed state of aggregation), or affords no perceptible resistance to volume change (the so-called permanent equilibrium in the gas state), *i.e.* in both cases the body can neither supply nor accept any perceptible external work at the null-point isotherm. In § 3 it is shown that since only physically possible cases arise, $(\partial p/\partial v)_T$ must of necessity be always negative. In order to remove the *a priori* physically impossible cases the function $\psi(v)$ must be put zero in the general integral $p = T\phi(v) + \psi(v)$. § 4 discussed the final equation of state which forms an ideal limiting case when every possibility of contradiction with the second law of thermodynamics is excluded. H. H. Ho.

**1150.** *On the Physical Significance of the Reciprocal Theorem.* **W. Jazyna.** (Zeits. f. Physik, 30. 6. pp. 376–379, 1924.)—This paper is supplementary to a previous one [see Abstract 3005 (1924)]. It demonstrates that if the mechanical operations in the molecule are denoted by T and regarded as active or direct actions, while the thermal are denoted by C(T) and regarded as passive or indirect, then the reciprocal theorem may be formulated as follows: If during isothermal change of the internal energy of a system C(T) is zero, then T must also be zero. Experience teaches that for a large number of states the inequality $C(T) > T$ is valid, and, since for large volumes T can be neglected, the deviations of gases from the ideal state may be regarded as exclusively due to C(T). H. H. Ho.

**1151.** *On the Problem of Systems related to Equations of State of the Form* $p = T\phi(v) + \psi(v)$. **N. J. Koltschin.** (Zeits. f. Physik, 31. 5–6. pp. 453–462, 1925.)—Reference is first made to a publication by Jazyna [see Abstract 2291 (1924)] in which a proof is given of the so-called reciprocal theorem (when $C_v = f(T)$, then U is only a function of T). Later Jazyna stated the validity of this theorem to depend on a latent condition from the intersection of the null point isotherm $T = 0$ with the null pressure isobar $p = 0$. The present author now establishes at which part of the proof the latent condition occurs, and also points out some objections to Jazyna's conclusions, which latter in some cases are in contradiction with the second law of thermodynamics. H. H. Ho.

**1152.** *On the Absolute Value of the Entropy of Real Gases. Part II.* **V. Njegovan.** (Zeits. Elektrochem. 31. pp. 5–6, Jan., 1925.)—In Part I [see Abstract 2299 (1924)] it was shown that the Planck expression for the so-called entropy constant of the perfect gas had also the same external form for real gases, taking into account the corresponding variables, $C_p = F(T, p) + C_p^0$ and $C_v = \Phi(T, p) + C_v^0$. By this assumption the entropy constant E is not constant but a function of the form $E = f(T, p) = k(C_p - C_v) + C_p = (k + 1)C_p - kC_v$, and the mathematical discussion of this variable forms the subject of the present note. The author suggests the term "Wärme extensität" for the altered conception of the entropy constant when applied to real gases. H. H. Ho.

# SOUND.

**1153.** *On the Velocity of Sound in Liquids and its Relation to Heats of Vaporisation.* **V. Ionescu.** (J. de Phyisque et le Radium, 5. pp. 377–383, Dec., 1924.)—The velocity of sound V in liquids has been connected with the heats of vaporisation L by the formulæ $V = \sqrt{L}$(Bogdan) and $V = \sqrt{\frac{L}{\alpha T}}$ (Lewis), $\alpha$ being the coefficient of expansion of the liquid under consideration and T the absolute temperature. In order to ascertain how far these theoretical relations are in agreement with facts, the velocity of sound in several liquids was measured. The liquids were introduced into a U-tube, and the time taken by the sound waves generated in the vicinity of one or other of the extremities of the tube to traverse it in either direction was photographically registered. The results obtained for alcohol, water, ether, acetone, toluene, petrol, benzine, xylol in the neighbourhood of 20° C. are in close agreement with the values deduced from Newton's formula, except for toluene. They show that the values of V given by Bogdan's formula are in general less, and those given by Lewis's somewhat greater than the experimental results. Illustrations of the apparatus and three tables are given. E. F.

**1154.** *Electrical Method of producing Vowel Sounds and its Application to Wireless Telegraphy.* **W. H. Eccles and C. F. A. Wagstaffe.** (Phys. Soc., Proc. 37. pp. 72–74, Dec., 1924.)—Details are given of a method of demonstrating the electrical production of vowel sounds, the method being originally proposed in connection with a system of W/T communication. Paget has shown that vowel sounds consist of a certain small number of voice frequencies—*e.g.* the vowel "ah" has 250, 800 and 1300~/sec. In the method of artificial production now described the transmitting circuit emits electrical oscillations of frequencies, say, 100,800 and 101,300. At the receiving station the wave produce corresponding oscillations, and are combined with a "local" frequency of 100,000 cycles per sec. in the well-known heterodyne method so as to produce currents of frequencies 800 and 1300. In order to simulate the vowel sound "ah" a current of voice frequency 250~/sec. is superposed either at the sending or the receiving station. Three ways of carrying out the above method have been tried successfully. A. B. W.

**1155.** *Powerful Source of Short-Sound Waves.* **M. Holtzmann.** (Phys. Zeits. 26. pp. 147–149, Jan. 15, 1925.)—A glass tube with a bulb at one end is rubbed, as with Kundt's tube, at the other end, the rubber being a motor-driven one of silk on leather moistened with alcohol. The apparatus is 100 to 150 times as powerful as a Galton whistle and gives a purer tone. It offers the possibility of producing waves down to 1 cm. length. It is claimed that the loudness can be varied within wide limits, and can be made constant to within 2%. G. E. A.

**1156.** *Absorption of Sound Waves in Turbid Media.* **W. Altberg** and **M. Holtzmann.** (Phys. Zeits. 26. pp. 149–153, Jan. 15, 1925.)—Theoretical research by Rayleigh, Lamb, and Sewell leads to the conclusion that absorption of sound energy by a medium containing suspended particles increases as the wave-length diminishes. The experiments of Tyndall and others show that waves of the order of 1 m. undergo no perceptible absorption in smoke or fog. Neklepajev has found, however, that waves of about 1 mm. length are strongly absorbed by air alone [see Abstract 1185 (1911)]. By testing waves with a range of lengths from 1·5 to 6·5 cm. the authors find increased absorption by smoke as the wave-length diminishes. The waves are set up in an enclosure by the bulb of a Kundt tube [see preceding Abstract] which projects through the wall. The intensity of the sound is measured by a torsion apparatus on one arm of which the waves impinge. A previous form of this instrument [Abstract 1471 (1904)] has been made much more sensitive. For the range of waves tested, the absorption by a layer of smoke 56 cm. thick, of which the concentration was $7\cdot 3 \times 10^{-6}$ gms. per c.c., varied from 24% for λ6·5 cm. to 70% for λ1·5 cm. A graph of absorption coefficients and wave-lengths is given among others. G. E. A.

**1157.** *Underblown Pipes.* **D. Gunnayya** and **G. Subrahmaniam.** (Phys. Soc., Proc. 37. pp. 15–18; Disc., 18–19, Dec., 1924.)—The phenomena of underblown pipes has been studied in the case of four wooden pipes of frequencies 256, 320, 384 and 512. All the four, by underblowing, give a tone starting below the fundamental and passing to a pitch above it as the pressure is slightly increased. The two lower pipes gave also the octave in a similar manner, the pressures used (though higher than before for the fundamental) being still below the usual pressure for the normal production of the fundamental.

**W. A. Benton** stated that in order to show whether these experiments supported or contradicted any theory it was indispensable to have full particulars of the pipes under test. E. H. B.

**1158.** *Vibration of a String under Intermittent Impulses.* **D. Gunnayya** and **G. Subrahmaniam.** (Phys. Rev. 25. pp. 99–100, Jan., 1925.)—Effect of a long obstacle slightly touching a vibrating string is to give it intermittent impulses with a frequency equal to that of the string. The equation of motion is given, and such impulses are shown to develop odd and even harmonics equally. The *tanpura* is such a case, and was found by experiment to give equally prominent odd and even harmonics up to the fifteenth. [See also Abstract 294 (1924).] AUTHORS

# ELECTRICITY AND MAGNETISM.

## THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

**1159.** *Theory of rapidly varying Electromagnetic Processes in Linear Conductors.* **R. Schachenmeier.** (Phys. Zeits. 26. pp. 54–58, Jan. 1, 1925.)—Starting from Maxwell's equations, the problem treated is the propagation of a given initial condition along an infinitely long conductor, and a method of successive approximations is adopted to obtain values for the current density, charge density, and electric and magnetic fields at a given place and time. Differential equations are then obtained which may be applied to the case of a coil. G. E. A.

**1160.** *Note on the Poynting Flux in a gradually varying Dielectric.* **J. A. Wilcken.** (Phil. Mag. 49. pp. 140–143, Jan., 1925.)

**1161.** *Dielectric Constants of Liquid Good Conductors.* **R. Fürth.** (Phys. Zeits. 25. pp. 676–678; Disc., 679, Dec. 15, 1924. Paper read before the Deut. Naturforscher u. Ärzte, Innsbruck, 1924.)—The capacity method and the field-method give inadequate results. The author's method is: Bring the liquid, of known conductivity $\sigma_0$ and unknown sp. ind. cap. $\epsilon_0$, between two parallel vertical metal plates, to which a constant or an alternating p.d. is applied. In the liquid suspend an exact ellipsoid of rotation of known $\sigma$ and $\epsilon$ with its axis of rotation horizontal and at 45° to the metal plates. Under the applied p.d. the ellipsoid experiences a turning moment, the expression for which contains (besides the constants of the apparatus) only the known $\sigma/\sigma_0$ and the unknown $\epsilon_0$, together with the square of the applied p.d. Experimental tests of the new method. In NaCl solution the sp. ind. cap. depends on the applied p.d., and also falls to a minimum, thereafter rising, with increasing concentration. A. D.

**1162.** *A New Electrostatics.* **H. Bateman.** (Phil. Mag. 49. pp. 1–22, Jan., 1925.)—In the two papers combined under this title the author continues his attempts to construct a theory of the structure of an electrostatic field in conformity with Einstein's gravitational theory, the quantum theory, and Bohr's theory of the H atom, the method employed being to set up various tensors specifying the distribution of stress, momentum and energy in the field of an electron in uniform rectilinear motion, and to compare the results with those deduced from the several theories mentioned above. Taking the second paper first, the author has shown [Mess. of Math. 53, p. 126, 1922] that it is possible to account for the existence of discrete electrons with a volume distribution of electricity of one sign, the electricity being everywhere in equilibrium. In the electrostatic case the tensor takes a simpler form because the retarded potential $\psi$, which is an invariant for the restricted theory transformations, then becomes equal to the electrostatic potential $\phi$. It is then shown that the theory of an electrified soapbubble, and that of the parallel plate condenser, become identical with the usual theory. The author states that it seems almost certain that this will hold whenever $\rho\phi$ is constant over each boundary of a layer of electricity, $\rho$ being the density of electricity. In this case a volume distribution of electricity can always be found which will make the body force vanish, and so a layer consisting of free electric charges only seems to be theoretically possible.

The first paper deals with the hypothetical structure of an electrostatic field generally, assuming the usual ideas relating to the energy and momentum in an electromagnetic field hold good for the *simple radiant fields* in which $E^2 = H^2$ and $(E\,H) = 0$, except that the usual expressions are multiplied by a constant factor which later on is made equal to 1/3. In these fields, then, energy and momentum flow in straight lines with the speed of light, the direction of flow at any point being that of the momentum. Dynamically the conditions then become comparable with the free flight of a system of particles without mutual influence and unaffected by external forces. These particles, on a reasonable hypothesis, might be called *quanta*, but the author keeps to the safer ground of calling them *field atoms*. He reminds us that the idea of making quanta responsible for the energy and momentum of an electromagnetic field of this type and for the forces which it exerts may be regarded as due to Einstein, and was developed by Lorentz in his Pasadena lectures. In classical electromagnetic theory there are stresses even in the field of an isolated electric charge, but in the core of an electron its supposed existence appears to suggest an explosion of the electron. A possible solution is found to be the conclusion that there is no momentum and no flow of energy in the field of an electron at rest or in uniform motion, the space outside the electron being entirely free from stress. Some modification would have to be made in the specification of the state of stress in an electromagnetic field. G. W. DE T.

**1163.** *General Law of Electrical Conduction in Dielectrics.* **S. W. Richardson.** (Roy. Soc., Proc. 107. pp. 101–112, Jan. 1, 1925.)—A continuation of the work carried out by the author in 1915 [Abstract 1747 (1915)]. If $\gamma$ = charging current, V = impressed p.d., Q = charge at time T, P = polarisation e.m.f., R = resistance of specimen, then the following relation, which the author believes to be the general law of electrical conduction in dielectrics, holds good for the results obtained by him in the case of quartz: $\gamma = dQ/dT + (V - P)/R$, or (charging current) = (polarisation current) + (conduction current). At sufficiently high temperatures, after the current has been flowing for some time, the behaviour of the specimen approximates to that of a metallic conductor carrying a steady current, while at very low temperatures it approximates to that of an air-condenser. Tables and curves are given of the experimental results obtained with specimens of quartz cut along and across the optical axis. A. H.

**1164.** *The Specific Inductive Capacity of Ice.* **B. de Lenaizan** and **J. Granier.** (Comptes Rendus, 180. pp. 198–199, Jan. 19, 1925.)—Two parallel wires were embedded in a block of ice and connected towards the ends by two bridges. Round one of these a wire was wound, and by means of a crystal detector was connected with a galvanometer, which showed when the circuit resonated to the circuit of a triode lamp.

This could be tuned by means of a condenser connected to the plate and grid. The block of ice was then removed, and a similar circuit substituted with a movable bridge, which was adjusted until resonance was obtained with the unaltered lamp circuit. Taking the square of the ratio of the lengths of the two internodes thus determined, allowing for the bridges, the value of the specific inductive capacity of ice was given as 2·17 at 4·5°. H. N. A.

**1165.** *On the Permanent Electret.* **M. Eguchi.** (Phil. Mag. 49. pp. 178–192, Jan., 1925.)—Describes apparatus designed for constructing and charging the permanent electret described in previous papers [Abstracts 688 (1921) and 1912 (1924)]. The electrisation of the interior of the disc of wax and resin, which has been allowed to solidify in an electrostatic field, is shown to be exceedingly permanent when the surfaces are kept covered with earthed tinfoil. The surface densities obtained on electrets exceed those produced on sealing-wax, shellac, sulphur, etc., by mechanical friction with wool or silk. The recovery of the surface charges, after discharging with X-rays, with a Bunsen flame, by planing the surface with a knife to a depth of some mm., and by washing with different reagents, was studied, and was found in all cases to be complete. H. N. A.

**1166.** *Mutual Action of Charged Particles in Liquid Media.* **E. F. Burton** and **J. E. Currie.** (Phil. Mag. 49. pp. 194–209, Jan., 1925. Paper read before the British Assoc., Toronto, 1924.)—Experiments of Dorn and others [Ann. d. Phys. V. p. 20, 1878; IX. p. 513, 1880; X. p. 46, 1880] on the charge carried by solid particles falling through a column of liquid have been repeated and extended to liquids other than water or aqueous solutions. Lead shot dropped through water, alcohol, benzene, toluene, and xylene carry down a negative charge; through turpentine and carbon tetrachloride a positive charge; and through ether no charge. Distinct evidence of a scattering due to the possession of a charge has been found, showing that there is undoubtedly a mutual repulsion existing between the particles of shot. A. B. W.

**1167.** *A Quantitative Analysis of a Four-Carrier Voss Machine.* **A. W. Simon.** (Phil. Mag. 49. pp. 257–262, Jan., 1925.)—A general quantitative theory of the influence electrostatic generator has already been given [see Abstract 2821 (1924)], and the present paper is concerned with the detailed analysis of a very simple electrostatic generator, the prototype of the Voss or Toepler-Holtz machines, consisting of four carriers and two inductors. H. H. Ho.

**1168.** *On the Fundamental Problem of Atmospheric Electrical Research.* **H. Benndorf.** (Phys. Zeits. 26. pp. 81–91, Jan. 1, 1925. Paper read before the Deut. Naturforscher u. Ärzte, Innsbruck, Sept., 1924.)—At the beginning of this century Elster and Geitel's discoveries initiated a new phase of research. After the rediscovery of the conductivity of the air the question arose: How is the constancy of the earth's electric field to be explained if, owing to the vertical current in the air, there is a continuous stream of positive electricity flowing towards the earth? This question constitutes the fundamental problem. A lengthy critical review of the work of previous investigators leads the author to the view that the only way of explaining at the same time the Bauer system of vertical currents and the maintenance of the earth's charge is to conceive these currents as $\beta$-rays of very high velocity. This explanation stands or falls with Swann's assumption that $\beta$-rays, with a speed comparable with that of light, cause no ionisation of the air. The treatment is largely mathematical. A bibliography is appended. E. F.

**1169.** *Correlations between Solar Activity and Atmospheric Electricity.* **L. A. Bauer.** (Terrest. Magn. 29. pp. 161–186, Dec., 1924.)—A continuation of a previous paper by the same author [Abstract 1534 (1924)]. During five of the past seven sunspot cycles the atmospheric potential gradient and the amplitudes of its diurnal and annual variations increased with the increase in sunspots. This relationship is apparently reversed in the other two cycles. The sunspot coefficients for atmospheric electricity and terrestrial magnetism show similar variations from year to year and from cycle to cycle. Atmospheric electric activity is subject to a double periodicity during the year of the same type as that existing in the variations of terrestrial magnetism, aurora, earth currents, and the "earth effect." A. W. L.

**1170.** *Experimental Investigations into Contact Electrification by Dust and Cloud-forming Powdered Substances, and especially with Snow as a Factor producing Storms.* **A. Stäger.** (Ann. d. Physik, 76. 1. pp. 49–70, Jan., 1925.)—A. Gockel's view that the whirling of snow, ice crystals, sleet and water-drops by squally air currents gave rise to storms with electrical disturbances was based on meteorological observations and statistics that such storms due to heat or whirls occur in conjunction with cirrus clouds. The author has carried out experiments with finely powdered substances such as sulphur, soot particles, flour, solid $CO_2$, and $NH_4Cl$ to trace the origin of the large quantities of electricity in such storms. Rudge's results [Abstract 1573 (1914)] and similar results of Kähler, Beyersdorfer and Kercher were incorrect owing to electrification of the dust on their grating collector. The author arranged to avoid this source of error. Further tests were made with snow, sleet, and icicles partly on the Jungfraujoch, and it was established that snow becomes electrified when swept along by air currents with a greater charge per cubic metre with increasing wind strength. Of the charged particles the smaller possessed positive and the larger negative charges, the latter falling more rapidly in the air. The magnitude of the charge per cubic metre was on occasion as large as 50 E.S.U. The author concludes that since heat and wind vortices occur in the presence of cirrus clouds, it is probable that the electrification of snow and ice crystals contributes to the origin of electrical storms. R. S. R.

## DISCHARGE AND OSCILLATIONS.

**1171.** *Theory and Experiments relating to Striated Glow Discharge in Mercury-Vapour.* **K. T. Compton, L. A. Turner** and **W. H. McCurdy.** (Phys. Rev. 24. pp. 597–615, Dec., 1924.)—For the case of parallel plane electrodes with a hot kathode as a source of electrons, the potential distribution and ion-concentration in the Crookes dark space, negative glow, Faraday dark space and positive column are shown to be predictable from considerations of space charge and of ionisation and excitation of the gas. While with weak currents there is a negative space charge throughout, sufficiently intense ionisation is shown to lead to a kathode drop, followed by a region of reversed electric field in which positive ions and electrons both move toward the anode by diffusion, owing to their large concentration gradient. Still farther from the kathode the field changes to its normal direction and increases up to the positive column. In the positive column the field and concentration are uniform unless atoms excited by electron impacts in certain layers are prevented from diffusing between the layers, when striations may be obtained with periodic changes of field and of concentration. The kathode edge of each striation has a positive space charge. The theory of the arc discharge is essentially the same, the arc being simply the negative glow of the longer glow discharge. Various predictions of the above theory of the glow discharge in a monatomic gas were verified by experiments with Hg vapour in vacuum tubes provided with hot kathodes: (1) Potential distribution and ion-concentration are investigated by Langmuir's modified probe method and found to agree with the theoretical deductions, except that the concentration of positive ions in the positive column comes out too large. This result indicates the presence of negative mercury ions. (2) The distribution of velocities of electrons is Maxwellian except between striations. (3) The emission of light seems associated more with excitation by electron collision than with ionisation and recombination. (4) Conditions for existence of striations. Striations are not found in pure Hg vapour unless the current is small or some substance like $H_2$ is introduced to remove excited atoms. (5) The presence of atomic hydrogen, which should be produced in the process of removing excited Hg atoms is proved by use of tungsten oxide. (6) Introduction of He, which cannot remove excited atoms, does not tend to produce striations. (7) The relative concentrations of excited atoms is determined from the optical absorption of subordinate series Hg lines. It is found that excited atoms exist in striations but not in the regions between, and are more numerous if the amount of $H_2$ impurity is reduced. The band spectrum of HgH seems associated with the action of excited Hg atoms on hydrogen, and is emitted as a result of inelastic collisions in striations. A. E. G.

**1172.** *The Dynamic Flame-Tension of the Glow Discharge.* **E. Mauz** and **R. Seeliger.** (Phys. Zeits. 26. pp. 47–51, Jan. 1, 1925.)—In the first part of this paper the theory of flame occurrence in discharge tubes is considered in a general manner. From the consideration of the flaming as a statistical procedure it appears that the flame-tension in general depends not only on the properties of the discharge tube itself, but also on the tension applied to the tube at the moment. Some special cases are discussed. In the second part measurements of the flame-tension of a pulsating discharge are described. A. E. G.

**1173.** *Time of Lag with the Spark Discharge.* **K. Zuber.** (Ann. d. Physik, 76. 2–3. pp. 231–260, Jan., 1925.)—An arrangement is described with which the distribution curve of times of lag, and with it the mean time of lag, can be determined. The mean time of lag is dependent upon the outer radiation of the spark tract. The mean time of lag is greater in dry than in moist air. The discharge causes a polarisation of the spark tract; the inclination towards polarisation is greater when ebonite is used. Further work is in progress [see next Abstract]. A. E. G.

**1174.** *Remarks on K. Zuber's Measurement of Time of Lag with Spark Discharge.* **M. v. Laue.** (Ann. d. Physik, 76. 2–3. pp. 261–265, Jan., 1925.)—This is a theoretical paper of a mathematical nature dealing with the investigations of Zuber [see preceding Abstract] on time of lag with the spark discharge. A. E. G.

**1175.** *Electrical Explosion of Tungsten Wires.* **H. V. A. Briscoe, P. L. Robinson** and **G. E. Stephenson.** (Chem. Soc., J. 127. pp. 240–247, Jan., 1925.)—The phenomena accompanying heavy high-tension discharges in thin metallic wires were first studied by Anderson in 1920. Using a large glass plate and tin-foil condenser, he photographed the spectra of the light emitted by the electrical explosion of iron, copper, nickel and manganin wires and observed very interesting effects, notably a reversal of many lines, producing an absorption (Fraunhofer) spectrum instead of the bright-line spectrum usually observed. These phenomena are attributable to the momentary attainment of an exceptionally high temperature in the substance of the wire. In 1922 Wendt and Irion reported the results of experiments on the explosion of fine tungsten wires by Anderson's method. When the explosions were carried out in a vacuum, some gas was formed, and this, subjected to an ordinary high-tension discharge, gave a spectrum in which the yellow helium line, $D_3$, was consistently observed. When the wires were exploded in an atmosphere of $CO_2$ at ordinary pressure, and the $CO_2$ afterwards absorbed in KHO solution, residual gas, averaging 1·42 c.c. per milligramme of tungsten remained. This gas was lost before its spectrum had been investigated. If it consisted wholly or mainly of helium, it was on the average some 25 % of the weight of tungsten taken. These results were so startling, and, if correct, of such profound significance, that the experiments here described are undertaken to confirm them. A fine tungsten wire is supported between heavy electrodes sealed into a glass vessel. This vessel is evacuated, and a heavy discharge is passed from a condenser of large capacity. Then an ordinary high-tension discharge is passed through a capillary side tube on the bulb, and the emitted light spectroscopically examined. It is concluded that these experiments afford no evidence that tungsten can be made to yield helium when exploded by an electrical discharge. At the same time it is clear that extreme difficulties attend any attempt at a crucial experiment on these lines, and much more importance is attached to experiments now in progress on the electrical explosion of tungsten wires in relatively dense and non-conducting atmospheres of absorbable gas. The conclusion is, however, supported by experiments of S. Smith and those of Harkins and Allison, and so it would appear that the statement of Wendt and Irion as to formation of helium has no foundation in fact. A. E. G.

**1176.** *The Effect of Surface Charges in Vacuum Discharge Tubes.* **A. R. Olson** and **T. F. Young.** (Phys. Rev. 25. pp. 58–65, Jan., 1925.)—Current-voltage curves obtained with a four-electrode tube with two rather widely separated gauzes showed discontinuities at voltages which were evidently not critical potentials, since they varied with the gas pressure. Since charges on the glass surface were thought to be responsible, a simple case was studied. Electrons were accelerated from a filament through two gauzes, 3·3 cm. apart, and held at the same potential to a plate, the space between the gauzes being surrounded by a metal cylinder C insulated from both. This cylinder became negatively charged until the loss or leak just equalled the gain due to the faster electrons. As the accelerating voltage $A_1$ was increased, a value *b* was reached, at which both the voltage of C and the current suddenly increased greatly, and these larger values were maintained until $A_1$ was decreased to a limit *a*, considerably lower than *b*. A study of the equipotential surfaces gives an explanation of these effects. The discontinuities may be eliminated by controlling the voltage of the cylinder C. In experiments in which electron velocities must be known, it is evidently necessary that insulated "floating" surfaces be avoided and that the potential of all parts of the wall be controlled. AUTHORS.

**1177.** *On Some Properties of Neon Tubes.* **B. N. Ghose.** (Phys. Rev. 25. pp. 66–68, Jan., 1925.)—The current through the tube is intermittent; the frequency being in the audible range if sufficient resistance (10 megohms) is placed in series. No current flows unless the applied voltage lies between two critical values. The voltage drop through the lamp, the product of the current and resistance as measured with d.c. instruments, is independent of the current and is approximately equal to the mean of the two critical voltages. The light intensity is directly proportional to the current. From the ratio of the light intensities of the lamp when in series with a known and with an unknown resistance, the latter may be determined. The method is quick and easy.

AUTHOR.

**1178.** *Spectral Energy Characteristics of the Mercury-Vapour Lamp.* **G. R. Harrison** and **G. S. Forbes.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 1–17, Jan., 1925.)—By means of a large aperture quartz spectroradiometer the spectral energy distribution of a special variable-length mercury lamp was measured between 14,000 Å. and 2300 Å. under widely varying conditions. The effects of current, voltage and ventilation on the radiation at fifteen important maxima were measured, including three maxima in the infra-red, four in the visible, and eight in the ultra-violet. The composition of each maximum is given, and curves are plotted showing the degree of resolution used; the variation in intensity of each maximum with voltage gradient at constant current; the variation of intensity of the strong ultra-violet maximum near 3660 Å. with voltage for five current values from 2 to 4 amps.; the stationary characteristic curves of a high-pressure arc; two typical cases of spectral energy distribution at constant power; and the variation with current of the intensity of each maximum at constant power. It was found that for constant current the energy in each maximum except those in the infra-red increased linearly with the voltage after a certain minimum (near 8 volts for 2·5 amps.) was reached. The pressure was measured for each stationary state used, the extreme values being 20 mm. of mercury and 2 atmos. Where power input was constant the energy radiated in each maximum increased rapidly with decreasing current. It was found that the most satisfactory condition for running an arc at pressures under 2 atmos., at least, was to have the pressure as high as possible, so that for a given power input the voltage was high and the current low. This condition gives the greatest efficiency and the least change in energy distribution with total energy variation. The relation of pressure to

the other variables and the effects at higher pressures are being investigated further; also an absolute determination is being made of the energy available in each wave-length for photochemical purposes.
AUTHORS.

**1179.** *The Quartz Mercury Lamp as a Photochemical Light Source.* **L. Reeve.** (J. Phys. Chem. 29. pp. 39–57, Jan., 1925.)—After a brief introductory note by A. J. Allmand, this paper gives an account of some of the problems which enter into the use of the quartz mercury-vapour lamp as a quantitative light source for photochemical investigations. It is based partly upon an extensive survey of the literature on the subject, and partly upon some three years' experience in the use of these lamps. The method of determining the energy distribution in its radiation is described and the investigations upon this point mentioned. An examination of these shows that, firstly, most of them are incomplete; secondly, that there are marked differences between them. These differences have been shown to be due most probably to differences in the following factors: (1) The electrical conditions of the lamp; (2) the dimensions of the lamp; (3) the age of the lamp, each of which are then discussed in turn, and various practical considerations given as the result of the conclusions arrived at.
A. E. G.

**1180.** *Phenomena with Negatively Charged Probes and with Particles suspended in Gas Discharge Tubes.* **W. Dällenbach, E. Gerecke** and **E. Stoll.** (Phys. Zeits. 26. pp. 10–22, Jan. 1, 1925.)—Research with a double probe in the positive column of a vacuum arc has shown that the potential of the probe does not agree with the potential of the surrounding gas before the introduction of the probe. The charging of the probe is appreciably affected by the density and velocity distribution of the ions and electrons streaming over its surface. Experiments on suspended particles gave results which permit explanations to be given of various effects in connection with arcs and with the zones of glow discharges. It was found that mercury ions striking an iron surface with velocities up to 3000 volts release from the surface no measurable electron current.
A. W.

**1181.** *The Thermionic Work Function of Oxide-coated Platinum.* **G. Davisson** and **L. H. Germer.** (Phys. Rev. 24. pp. 666–682, Dec., 1924.)—Measurements of the thermionic work function of pure platinum coated with oxides of barium and strontium have been made simultaneously by the calorimetric and the temperature variation methods for the same segment of a uniformly heated filament. The theory of the measurements and the experimental arrangements are the same as used in an earlier experiment on the thermionic work function of pure tungsten. Filament temperatures accurate to ± 5° were found from the resistance of the filament at 0° C. in conjunction with the temperature coefficients of resistance. For 1064° K. the two methods give values for the work function $\phi$ in agreement. The measurements are, however, not sufficiently accurate to give any indication whether or not an electron within the metal possesses the thermal energy $3kT/2$. The various corrections made, and possible errors, are thoroughly discussed. It is pointed out that if the transition from the equilibrium state at one temperature to that at another had occurred so rapidly as to avoid observation, a dis-

agreement of 25 % between the values of $\phi$ given by the two methods would have been obtained which might have been misinterpreted.
**Authors.**

**1182.** *Thermionic Effects caused by Vapours of Alkali Metals.* **I. Langmuir** and **K. H. Kingdon.** (Roy. Soc., Proc. 107. pp. 61–79, Jan. 1, 1925.)—From thermodynamic considerations involving the Saha equation it is concluded that there must be a relation between the positive ion emission from a heated filament in the vapour of an alkali metal and the electron emission from this surface. At high filament temperatures and low pressures of the vapour the electron emission is the same as in the absence of the vapour, so that the positive ion emission from different filaments in various vapours can be calculated. Experiments with cæsium and other metallic vapours, and with tungsten filaments and oxygen-coated and thorium-coated filaments, give results in accord with this theory. Measurements of the positive ion and electron emissions from tungsten filaments in cæsium vapour give values for the thermal ionisation of cæsium vapour at about 1200° K. in excellent agreement with the Saha equation. At high filament temperatures the positive ion emission becomes limited by the rate at which the vapour comes into contact with the filament, all atoms striking the filament being converted into ions [Abstract 1436 (1923)]. This permits quantitative measurements of the vapour pressure to be made. At lower filament temperatures the electric image force causes a fraction of the filament surface to be covered by a layer of adsorbed ions, which share electrons with the underlying metal. The resulting double layer causes an increase in electron emission and a corresponding decrease in positive ion emission. Electron emission of over 0·3 amp. per cm.$^2$ at 1000°K. may be obtained in cæsium vapour at 30° C. A more detailed account of the experiments will be given in a later paper to be published in the *Physical Review.* A. W.

**1183.** *Electronic Bombardment of Metal Surfaces.* **H. E. Farnsworth.** (Phys. Rev. 25. pp. 41–57, Jan., 1925.)—A continuation of previous work [Abstract 356 (1923)] by the author. The present experiments are concerned firstly with obtaining the secondary electron characteristics of other metals (Cu, Ag, Au, W, Pt, Pd, Mg, and Al), using the same apparatus as that previously described; and secondly, with experiments made with the apparatus modified so as to permit a more detailed and varied study of conditions in certain cases. Curves are given showing the ratio of secondary (emergent) to primary (incident) electron current as a function of primary velocity (0 to 250 volts). The curves depend on the previous heat treatment of the metals. A. B. W.

**1184.** *Absorption of Kathode Rays in Aluminium Foil.* **H. M. Terrill.** (Phys. Rev. 24. pp. 616–621, Dec., 1924.)—The experimental method used is a modification of that of Whiddington and of Schonland [see Abstract 131 (1924)]. Homogeneous rays of accurately known velocity are provided by fitting a Coolidge kathode to a high vacuum tube and exciting it by high-tension direct current. The stream of electrons traverses the foil and enters a Faraday cylinder connected to a galvanometer. The foil may be swung aside to permit measurements of the direct beam. One to three foils of rolled aluminium 0·00031 cm. thick are studied with voltages 18 to 52 kv. Up to the vicinity of the range limit, Lenard's equation $I/I_0 = e^{-ax}$ is found to hold where $x$ is the thickness. Within this range of velocities, 8·09 to 12·23 × $10^9$ cm./sec., the values of $a$ satisfy the approximate relation derived by J. J. Thomson, $av^4 = 0 \cdot 268(10^{44})$, where $v$ is the mean of the velocities before and after penetrating the foil. A. E. G.

**1185.** *The Lighting of Canal Rays at High Pressures and the Question of the Delay Time* (*Verweilzeit*). **W. Wien.** (Ann. d. Physik, 76. 2–3. pp. 109–123, Jan., 1925.)—After a mathematical discussion of the theoretical basis the experimental arrangement is described. As a result of the present experiments it is decided that the striking time (Abklingungzeit) and delay time (Verweilzeit) are only different representations of the same occurrence. [See also Abstract 1441 (1923).] A. E. G.

**1186.** *Mobility of Actinium Active Deposit Ions.* **H. A. Erikson.** (Phys. Rev. 24. pp. 622–626, Dec., 1924.)—The mobility of the ions in actinium active deposit is determined by drawing them across an air stream having a speed of 20 m./sec. by means of an electric field of over 100 volt/cm. and allowing them to deposit on a metal plate. The amount of deposit at various distances along the plate is determined by the ionisation it produces through a slit in the wall of an ionisation chamber. It is found that two positive ions are present, one of which has a mobility of about 4·35 cm./sec./volt/cm. and the other 1·55. The first is greater than that of mono-molecular ions of air and the second greater than that of bi-molecular ions of air. The interpretation advanced is that the more rapid ions are atomic actinium A and B, and that the slower ion is formed when the more rapid ion attaches itself to a neutral molecule, presumably air. A comparison of the results in the case of these heavy ions with those in the case of the air and $CO_2$ ions shows that the mobility of an ion is practically independent of its mass. A. E. G.

**1187.** *Mobility of Negative Ions in Flames by the Hall-Effect Method.* **J. S. Watt.** (Phys. Rev. 25. pp. 69–74, Jan., 1925.)—Using a flat salted flame, previously described by Wilson, between the poles of an electromagnet giving a field of 5000 gauss, the horizontal potential gradient X, due to the current sent between two Pt electrodes and also the vertical potential gradient Y due to the Hall-effect, were measured by means of two Pt sounding wires, which could be rotated about a horizontal axis and which were connected to a quadrant electrometer. For a flame containing potassium carbonate the mobility $k_2 = Y/HX$ was found to decrease from 26 m./sec. for 1 volt/cm. when the potential gradient was 1 volt/cm. to 16 m./sec. for a gradient of 30 volts/cm. For a flame free from salt the mobility was somewhat greater, decreasing from 26·5 m./sec. for 5 volts/cm. to 16 m./sec. for 50 volts/cm. The Hall-effect was found to vary slightly with the direction of the magnetic field, the asymmetry being greater, the greater the amount of salt in the flame. This asymmetry was probably due to the effect of the magnetic field on the upward velocity of the flame gases, which was evident in these experiments. AUTHOR.

**1188.** *Absorption in Excited Neon.* **K. W. Meissner.** (Ann. d. Physik, 76. 2–3. pp. 124–144, Jan., 1925.)—After a complete description, with diagram of the apparatus employed, the subject is dealt with as follows: Ocular observations; photographic methods; a discussion of the blackening measurements; the results of the measurements; the influence of impurities. A. E. G.

**1189.** *Absorption of Short Waves.* **J. Granier.** (Onde Élec. 3. pp. 572–582, Dec., 1924.)—Measurements were made of the resistance of wires of various types and under various conditions, when forming part of an oscillatory circuit in resonance with the radiation from a valve generator giving very short waves of wave-length less than 3 m. The skin effect was found to be of very great importance, tinned copper wires having a much greater resistance than bare copper wires, and being considerably worse than galvanised-iron wires. Some interesting results were obtained with distilled water and with salt solutions. Measurements of dielectric losses at these high frequencies show paraffin and mica to be much better than any other substance tested, having losses about eight or nine times less than ebonite, and seventy times less than damp wood. Typical valve arrangements for producing very short waves are illustrated and described. A. W.

**1190.** *Method of Producing Short Wave-length Oscillations in Electron Tubes.* **G. Breit.** (Optical Soc. of America, J. and Rev. Sci. Inst. 9. pp. 709–722, Dec., 1924.)—A description of a short wave-length oscillation in an electron tube having singular properties has been given by the writer [see Abstract 1903 (1924)]. The oscillation takes place in a three-electrode tube having a cylindrical structure, the filament and grid being helical and bifilarly wound, while the plate is coaxial with the filament and grid. The negative pole of a battery is connected to the filament and the positive through a resistance to the grid. The plate is left disconnected. Oscillations take place when the filament temperature has the proper value. In the previous paper the writer detected the oscillations by means of a crystal detector and galvanometer, and their wave-lengths have been ascertained to be either in the neighbourhood of 60 cm. or in that of 150 cm. These oscillations are now studied farther by investigating the negative potential to which the plate is charged. The oscillation is shown to depend critically on the exact position of the grid with respect to the filament, and evidence is given for regarding the oscillation as first starting in one part of the tube and then spreading by steps through the whole structure. The relation of the oscillation range to the characteristic curves indicates an influence of space charge. Strong hysteresis effects with and without a magnetic field are observed. A. E. G.

**1191.** *Theory of Frequency Multiplication.* **O. Emersleben.** (Zeits. f. Hochfrequenztechn. 24. 5. pp. 105–114, 1924.)—This paper is mainly of a theoretical nature, and deals with the subject under the following sections: (1) Frequency multiplication by means of over-oscillations; (2) frequency multiplication by means of shock excitation; (3) a comparison of the above methods. A. E. G.

**1192.** *Determination of the Free Period of a Short Two-layer Coil.* **A. Goosmann.** (Archiv f. Elektrot. 14. pp. 258–303, Feb. 3, 1925.)—An analytical treatment of this problem [see Abstract 1107 (1914)]. A. H.

## ELECTRICAL PROPERTIES AND INSTRUMENTS.

**1193.** *On an Analogy in the Behaviour of Conducting and Non-Conducting Mixtures.* **K. Lichtenecker.** (Phys. Zeits. 25. pp. 666–670, Dec. 15, 1924.)—This paper contains a more comprehensive account of work already briefly published [see Abstract 2333 (1924)] on the conductivity of metallic aggregates and the dielectric constants of the Wiener mixed bodies. Ficker's data compiled for Wiener [Leipzig Diss. 1909] are confirmed for the range employed in the present investigation. The general resistance function (logarithmic rule of mixtures) for two- and three-dimensional aggregates agrees entirely with Ficker's measurements. The formula of Lorenz-Lorentz applies to aggregates in which the component of greater DK is only sprinkled throughout the mixture, but gives low values when both are sprinkled or aggregated. The paper concludes with a discussion of Wiener's conclusions as to a theoretical preference for the logarithmic rule of mixtures over the Lorenz-Lorentz formula and the evaluation of DK by the author's method. [See Abstract 458 (1910).]
H. H. Ho.

**1194.** *The Law of Variation of Conductivity of Solid Salts with Temperature and its Possible Connection with the Characteristic Spectrum of the Metal of the Salt.* **P. Vaillant.** (Comptes Rendus, 180. pp. 206–208, Jan. 19, 1925.)—Reference is made to the exponential relation between the current passing through a layer of a dry salt at different temperatures while the e.m.f. is maintained constant [see Abstract 3051 (1924)]. Assuming that the free electrons in the salt convey this current, and that the electrons are set free by the absorption of radiant energy, the wave-length of this radiation is determined from known constants for rock-salt, $K_2SO_4$, KCl and LiCl. In each case the wave-length found agrees with a well-marked line in the spectrum of Na, K, or Li respectively. This explains also how the absorption of the energy sets free an electron, and the emission of the radiation corresponds to the passage of an electron from one trajectory to another of smaller radius. R. S. R.

**1195.** *Theory of Electrostriction in Insulating Liquids.* **G. Bruhat** and **M. Pauthenier.** (J. de Physique et le Radium, 6. pp. 1–9, Jan., 1925.)—When electrostriction is produced in a liquid, the equilibrium reached depends upon the operation being performed adiabatically or isothermally. The former occurs with rates of charging less than 0·001 sec. Expressions are obtained for these two cases by thermodynamical reasoning which give the contraction per unit volume of the liquid. Electrostriction is made evident by alterations of the refractive index of the liquid, and an expression is obtained connecting the changes of refractive index and specific volume. The change is observed experimentally by an interferometer method with $CS_2$, $CCl_4$, and benzene. Experimental results are of the same order as those obtained by theoretical considerations, but mostly smaller. The theory, however, involves many uncertainties, and even so good an agreement could hardly be expected. R. S. R.

**1196.** *Behaviour of Silver Iodide in the Photo-Voltaic Cell: A New Type of Silver Iodide Photo-Voltaic Cell.* **A. Garrison.** (J. Phys. Chem. 29. 58–67, Jan., 1925.)—This work on silver iodide is a continuation of an investigation of the cuprous oxide and silver halide photo-voltaic cells [see Abstract 1325 (1924)] and the related photo-chemical and photo-physical properties [see Abstract 2190 (1924)] which has been carried on under an appointment of the Research Fellowship Board of the National Research Council. The light-sensitive electrodes used in the first experiments with silver iodide were prepared by depositing crystals of the salt in a thin layer over a plate of metallic silver. These electrodes were found to become either positive or negative on illumination, depending on certain conditions of the electrode or electrolyte. The experiments recorded in this paper are performed on a different type of electrode, one whose properties are in some particulars better adapted to the discovery of the relation between the colour or wave-length of the light rays and the extent and nature of the photo-chemical action. Therefore the experiments with this electrode have given results of importance bearing on a phase of the problem which has been only slightly developed. The complete photo-voltaic cell, as well as the method of observation, is the same as that described in the previous paper on silver iodide, with the exception of the light-sensitive electrode and its method of preparation. This consisted of a gold plate 2 cm. wide and 3 cm. long, over which a thin film of molten silver iodide had been spread and permitted to solidify. The gold acts only as an inert metallic support for the apparently amorphous silver iodide. Electrodes having the same properties are made on plates of both platinum and palladium. The entire front surface of the electrode is covered uniformly with silver iodide, and the entire back surface is covered with paraffin. It is found that the max. photo-potential is not proportional to the light intensity, but becomes almost constant at high intensities. The rate of rise of the potential is proportional to the light intensity at the beginning of the illumination. This is true for light of any colour. An investigation of the effect of light of different colours in bands of various widths reveals the fact that white light has the largest effect. For a fixed intensity of light the rate of the chemical change decreases as the light is made more nearly monochromatic. This is true in any part of the visible spectrum. A newly prepared electrode is more sensitive to the blue region, but illumination in this region intensified the effect of the red and green light. After continued illumination the electrode is more sensitive to the red region. A theory is suggested to explain these facts. A. E. G.

**1197.** *On the Influence of Temperature upon the Photoelectric Effect*. **J. R. Nielsen.** (Phys. Rev. 25. pp. 30–40, Jan., 1925.)—A discussion is given of the suggestion by Millikan that in the photoelectric effect the energy of the light is transferred to the free electrons of the metals as well as to the bound electrons, and the threshold frequency $\nu_0$ is interpreted by the equation $h\nu_0 = \phi_p - E_k$ where $\phi_p$ is the work necessary to remove a free electron from the metal. In cases where $E_k$ is not small compared with $\phi_p$ the theory leads to a lack of sharpness in the definition of $\nu_0$. Neglecting variations of kinetic energy, the difference of stopping potentials comes out equal to the Peltier coefficient; hence the uniformity of stopping potentials for different metals observed by Millikan is due, according to the theory, to the smallness of the Peltier effect. The variation of the long wave-length limit with temperature comes out $\partial\lambda_0/\partial T = (\lambda_0^2/hc)e\sigma$, $\sigma$ being the Thomson coefficient. In most cases $\lambda_0$ should be practically independent of temperature. In the case of aluminium, after prolonged heating, the photoelectric current due to $\lambda 2537$ was found to remain constant within ½ % as the target was cooled from 400° to 100° C., and this constancy is interpreted as evidence that the shift of the long wave-length limit with change of temperature is less than 1 Å. The limit was found to be at about 2700 Å. Similar observations with a nickel target and 2412 Å. gave inconclusive results, as in spite of heating to 1300° C. and reduction of the oxide on the surface by heating in hydrogen, reproducible results were not obtained. Photoelectric current from aluminium for λ2537.—(1) Effect of prolonged heating in vacuum by high-frequency induction for many hours to near the melting-point. The current remained strong. (2) Effect of cooling from 400° to 100° C. The current remained constant within ½ %. AUTHOR.

**1198.** *The Photoelectric Response of Potassium at Low Temperatures.* **J. W. Hornbeck.** (Phys. Rev. 24. pp. 631–638, Dec., 1924.)—Carefully purified potassium in a highly evacuated tube surrounded by a double-walled container for liquid air, insulated by wool, was illuminated with monochromatic light of constant intensity. As independently observed by Ives, the current wave-length curve at − 180° C. is shifted to shorter wave-lengths with respect to the curve at 20° C., the shift decreasing from about 500 Å. at the long wave limit 6500 Å., to 80 Å. in the blue. These shifts are reversible and reproducible. Monochromatic heating and cooling curves run approximately parallel to the temperature axis except between − 80° and − 100°, where they show a sudden change. This region is where a change of crystal structure is known to take place. The shifts observed, then, seem to be due in part, at least, to the change of crystal structure. This point needs further study. Slight sudden changes of temperature produced irregular effects which are not understood; they may possibly be associated with the condensation of new vapour or with cracks in the surface. AUTHOR.

**1199.** *On the Incident and Emergent Velocities of Photoelectrons emitted from Thin Platinum Films.* **Chien Cha.** (Phil. Mag. 49. pp. 262–272, Jan., 1925. Paper read before the Am. Phys. Soc., Dec., 1923.)—The asymmetry of incident and emergent photoelectrons emitted from "sputtered" and evaporated films is discussed, reference being made to previous work by Robinson and Stuhlmann [see Abstract 1030 (1913)]. An experimental arrangement to produce photoelectrons is described in detail with methods of producing sputtered and evaporated films of platinum. The photoelectric emission of such films were measured both for monochromatic and unresolved light. To test the value of the results, Planck's constant "*h*" was calculated from the data for evaporated films, and, unlike the value obtained by Robinson and Stuhlmann, which differed by 10 to 20 % of the accepted value, the present author obtained a value only 2 % too low in relation to Milligan's value, a difference attributable to the experimental conditions. The residual gases which are occluded or absorbed during the process of "sputtering" are considered as the cause of lack of symmetry observed with sputtered films, this gas reducing the velocities of the electrons emitted by the incident light, and so causing an excess of the emergent over the incident velocity. B. J. L.

**1200.** *The Connections between the Four Transverse Galvanomagnetic and Thermomagnetic Phenomena.* **P. W. Bridgman.** (Phys. Rev. 24.

pp. 644–651, Dec., 1924.)—When a rectangular plate, thickness $d$, placed normal to a magnetic field H, is traversed lengthwise by an electric current I, a transverse potential difference (Hall effect) $E = RHI/d$ is established. Similarly a transverse temperature difference (Ettingshausen effect) $\Delta t = PHI/d$ occurs. When a flow of heat, W units per sec., is substituted for the longitudinal electric current, there is a transverse potential difference (Nernst effect) $E = QHW/\kappa d$ and a transverse temperature difference (Righi-Leduc effect) $\Delta T = SHW/\kappa d$ where $\kappa$ is the thermal conductivity of the material of the plate. The following relations between the coefficients P, Q, R and S of these four phenomena can be shown to exist: $P = (T\sigma/\kappa\rho)R$, $Q = (\sigma/\rho)R$, $S = (1/\rho)R$, in which $\sigma$ = coefficient of the Thomson effect, $\rho$ = specific resistance of the material of the plate. The relation independent of $\sigma$ is $PR/QS = \rho T/\kappa$. Comparison is then made with available data showing agreement within experimental error:—

| Metal | Ag | Al | Cd | Co | Cu | Fe | Ni | Zn | Au | Sb | Bi |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $PT/\kappa \times 10^{-8}$ | 12 | 41 | 240 | 480 | 14 | 600 | 590 | 165 | 25 | 7,250 | 59,400 |
| $PR/QS \times 10^{-8}$ | 28 | 163 | 240 | 620 | 22 | 750 | 350 | 250 | 15 | 12,000 | 500,000 |

L. L.

**1201.** *Galvanomagnetic Phenomena in Flames.* **C. W. Heaps.** (Phys. Rev. 24. pp. 652–657, Dec., 1924.)—An expression for the Hall-effect in flames has been derived by H. A. Wilson from which the value of the mobility of the negative ions may be deduced. The values so obtained range around 20 m. per sec. under a gradient of 1 volt per cm., whereas other methods give values from 60 to 200 m. per sec. Also, Wilson's expression for the change in resistance of the flame under a magnetic fiel[illegible]equires a value for the upward velocity of the flame gases about 100 times greater than that observed. The theory of Marx is no more satisfactory than that of Wilson. In the present paper the author derives equations for the Hall-effect and the change of resistance in the magnetic field which agree more closely with experiment. He assumes that the Hall e.m.f., produced by the deflection of the negative ions, exerts a dragging effect on the positive ions, which in turn exert and drag on the upward moving flame molecules, and thus alter the upward velocity of the flame gases. Combining the expressions for the two effects he obtains the relation:—

$$Y(1 + dR/R)/XH = k_1 - k_2$$

convenient for experimental work. Y is the vertical potential gradient produced by the magnetic field H normal to Y and to the horizontal potential gradient X; $dR/R$ is the magneto-resistance effect; $k_1$ $k_2$ the mobilities of the positive and negative ions. L. L.

**1202.** *An Electrolytic Frequency Meter of Simple Construction.* **A. P. Rollet.** (Comptes Rendus, 179. pp. 1598–1600, Dec. 29, 1924.)—This apparatus is based upon the phenomena of successive oxidation and reduction which an electrode of silver undergoes when an alkaline solution is electrolysed by an alternating current of low frequency. To show the chemical reactions which are produced at the surface of the silver all that is necessary is to withdraw the electrode from the electrolytic bath, during the passage of the current, with a very rapid movement. In the apparatus here described, in order to obtain very clear lines, the electrolyte (potash or soda) must have a concentration of 1 to 4 %. The intensity of the current may vary from 1 to 3 amps. The electrodes are two silver wires

1 mm. diameter. The results obtained are quite satisfactory, and it seems possible that frequencies up to 100 can be measured by this means.
A. E. G.

**1203.** *A Universal Calibration Curve for Ballistic Galvanometers.* **D. P. Randall.** (Phys. Rev. 25. pp. 85–89, Jan., 1925.)—On closed circuit, the throws produced by a given discharge depend on the circuit resistance because of its effect on the damping. No simple relation between sensitivity and circuit resistance is known which is applicable to a wide range of instruments and damping. However, if sensitivity is expressed as a fraction of undamped sensitivity, and circuit resistance as a fraction of critical damping resistance, a general mathematical relation between these two quantities is obtained which is true for all moving-coil type instruments. Numerical data are given and also the curve. A special damping coil may be treated as an equivalent parallel circuit, and the joint effect determined accordingly. The accuracy is limited only by the precision of measurement of undamped sensitivity and critical damping resistance, as no approximations are involved in the derivation.
AUTHOR.

**1204.** *Studies on Dielectric Hysteresis and Allied Phenomena. Part III.* **H. Saegusa.** (Tôhuku Univ., Sci. Reports, 13. pp. 179–185, Nov., 1924. In English. Paper read before the Math. Phys. Soc. Japan, April, 1922.)—Particulars are given of the dielectric hysteresis and allied phenomena exhibited by dielectrics including ambroid, paraffin, paper, sulphur, ebonite and glass. A comparison of the results with those obtained in previous work [see Abstract 2263 (1923)] shows that the forms of the plastic hysteresis and stationary hysteresis loops are not so different in the substances investigated as in the case of non-metallic isolated crystals, but they are different even for the same material. The stationary potential due to the time effect in the specimen and the saturation potential of the residual charge increases initially linearly with the applied potential until a limiting potential is attained; thereafter the curves indicating the relation of applied to saturation potential follow another less steep straight line in the case of ambroid, paper and paraffin, but the relation is not a linear one in the case of sulphur, ebonite and glass. A good insulating material in general is characterised by a large limit potential, a small time effect, a small residual charge and small hysteresis. An insulating material may be easily specified in terms of its behaviour as regards residual charge.
J. S. G. T.

**1205.** *Continuous Wave Syntoniser.* **H. L. Crowther.** (Journ. Sci. Instruments, 2. pp. 125–130, Jan., 1925.)—The syntoniser is a valve generator of feeble high-frequency alternating current, the periodicity of which can be varied over wide limits. The instrument is used for the measurement of the wave-length of high-frequency oscillations and also as a heterodyne for c.w. reception. The instrument described was developed by the Air Service during the war. The various applications of this syntoniser and also the method of its accurate calibration from a tuning-fork of known frequency are described in detail.
AUTHOR.

**1206.** *Simple Photographic Recorder and Oscillograph.* **A. Perot.** (Comptes Rendus, 180. pp. 130–132, Jan. 12, 1925.)—The author devised this simple recorder for the use of the Military Telegraphic Service during the war in recording high-frequency damped currents. It does not pretend to compete with the inertialess recorders of the laboratory. An ordinary photographic film is attached to the periphery of a steel flywheel with a circumference of 1 metre and capable of making up to 150 revs. per sec. The axle free from the wheel is run up to the desired speed, and then locked to the wheel, whereupon the wheel moves along the axis, the motion of the film thereby becoming helicoidal. After moving 50 mm. along the axis the wheel runs free from the axis, and is brought to rest by means of a dashpot. A 4-kw. electric motor is used for running up to the desired speed. A number of the photographs so taken are reproduced in this paper. G. W. DE T.

**1207.** *Measurement of Modulation.* **C. B. Jolliffe.** (Optical Soc. America, J. and Rev. Sci. Inst. 9. pp. 701–704, Dec., 1924.)—The electron tube peak voltmeter described by van der Bijl may be used as a means of measuring the modulation of a radio-frequency current whose maximum value for complete modulation varies between the limits zero and twice the maximum value of the unmodulated wave. A diagram and description of the required apparatus is given, with sample data showing the accuracy to be within about 4 %. A. W.

**1208.** *On the Voltage Amplification Ratio of the Triode Valve Resistance Amplifier.* **H. Nukiyama** and **T. Kuwashima.** (Tôhoku Univ., Technol. Reports, 4. 3. pp. 1–17, 1924. In English.)—Voltage amplification is measured for audio-frequency ranges by means of an alternating-current potentiometer, the alternating current being supplied by a valve. Relations of the amplification ratio to plate-circuit resistance and amplitude of applied grid voltage is studied. In an amplifier with a grid condenser, the grid voltage is affected by the rectifying action, and this causes a change in the ratio owing to the change in the amplitude of the input grid potential. The paper is partly mathematical, and has sections (1) methods of measurement, (2) mathematical definition of amplification ratio in the audio-frequency range, (3) average grid voltage, (4) static characteristics with plate resistance. A bibliography of the subject is given. B. J. L.

## ALTERNATING CURRENTS AND MAGNETISM.

**1209.** *Decomposition of the Energy of a Triphase System into a Constant and a Pulsating Energy.* **L. G. Stokvis.** (Comptes Rendus, 179. pp. 595–597, Sept. 29, 1924.)—The paper derives a simple formula analysing a triphase energy system into its components, and shows that it is easy to determine graphically, without any calculation, both the constant and the pulsating parts of the energy of the system. It is only necessary to decompose the system into synchronous and inverse components. By superposition of these components of potential and current upon one another and taking their sum, the total energy of the system is obtained. The paper is mathematical throughout. S. G. B.

**1210.** *Production of Direct and Broken Relative Frequencies with Iron Chokes without Previous Magnetising.* **L. Kasarnowski.** (Zeits. f. Physik, 30. 3. pp. 225–227, 1924.)—The possibility of generating and the conditions for producing double frequency by means of self-induction in iron chokes without previously magnetising by direct current was shown by Osnos in 1918. The production of general direct harmonics was independently first observed by the author in 1921. In the present paper a short history of the work on the subject is given [see also Abstract 173 (1925)]. A. E. G.

**1211.** *The Construction of Electromagnets.* **P. Villard.** (Comptes Rendus, 179. pp. 1365–1370, Dec. 15, 1924.)—The ordinary type of electromagnet usually has its coils wound upon cylindrical pole-pieces which are connected together by a massive block of iron. In the present paper the flux at different sections of the magnetic circuit of such a magnet has been measured for different magnetising currents. Due to the development of the free polarity on the polar surfaces, the flux in the iron near to the pole-pieces is less (about 10 %) than in other parts of the circuit. It appears that stronger fields can be obtained in the gap if that part of the iron upon which the coils are wound is not of uniform cross-section, but tapers somewhat, the narrow ends of the cones facing each other. In addition, it is suggested that the windings should be brought as near as is possible to the pole-piece tips. A. A. D.

**1212.** *Gans' Theory of Dia-, Para-, and Metamagnetism.* **G. H. Livens.** (Ann. d. Physik, 75. 8. pp. 819–824, Dec., 1924.)—It is pointed out that Gans' mathematical theory of magnetism contains several errors; these are specified. G. E. A.

**1213.** *W. Thomson's (Kelvin's) Theorem and its Application to the Problem of Magnetic Attraction when the Permeability is Variable.* **T. Lehmann.** (Rev. Gén. d'Él. 17. pp. 167–171, Jan. 31, 1925.)—The analogue of Kelvin's theorem of the electrostatic field, *viz.* that the energy of the field is a minimum in the equilibrium state, is shown to apply to the case of a magnetic field in which the permeability, depending upon the field strength, is variable. Formulæ are deduced for the attraction between two magnetic circuits in air, and it is shown that the assumption of the invariance of the magnetic distribution during a virtual displacement of the circuits leads to correct results. J. S. G. T.

**1214.** *Magnetic Properties of Thin Films of Ferromagnetic Metals produced by the Evaporation Method.* **A. J. Sorensen.** (Phys. Rev. 24. pp. 658–665, Dec., 1924.)—Films of Fe, Ni and Co were deposited on tin or Al foil by the method used by Steinberg [Abstract 1208 (1923)]. Armco iron (99·874 % pure iron), Ni, containing 0·27 % Fe. 0·05 % Cu and 0·004 % Mn were used for the Fe and Ni films. For the films of Co, the metal was first deposited electrolytically on tungsten wire. The weight of a film was of the order 0·001 gm. and the dimensions 7·5 cm. × 2·5 cm. The thickness varied from 20 to 300 $m\mu$. The film was rolled on a thin thread to form a uniform cylinder for insertion into a search coil. The intensity of magnetisation was measured by observing the change of flux in the search coil, situate in a uniform magnetising field, when the film cylinder was withdrawn. For requisite sensitiveness a special switch device was used for closing the secondary circuit for a definite interval of time. The maximum intensity of magnetisation of the Fe is of the same order as that in bulk; with Ni films it is considerably lower and with Co films the values are higher than those for the metal in bulk. The remanence is high for Fe and Co. The coercive force is high for all three metals, but lower values obtain at a certain critical thickness. The high values of the coercive force are probably due to the minute size of the crystals in the films. The present results, combined with Steinberg's results for the Hall-effect in films, do not support Kundt's conclusion that the Hall e.m.f. is proportional to the intensity of magnetisation. L. L.

**1215.** *Effect of Stress on the Magnetic Properties of Steel Wire.* **R. L. Sanford.** (Bureau of Standards, Sci. Papers, No. 496. pp. 681–695, 1924.)—The object of the investigation was to establish a quantitative relationship between stress and magnetic properties. Using high magnetic fields and the relationship $\rho = \alpha + \beta H$ where $\rho$ = metallic reluctivity and $\alpha$ and $\beta$ characteristic constants for the material, ballistic observations were made on steel wire over the region H = 100 to 800 and tensions from 0–102,000 lbs./sq. in. It is found that tension causes a departure from the linear relationship. The reluctivity curve for non-homogeneous material is the resultant of two or more straight lines expressing the magnetic properties of the components. Within the proportional limit there is approximately a linear relationship between the applied stress and the intercept on the $\rho$ axis of the asymptote of the reluctivity curve. W. V. M.

**1216.** *Magnetism of Annealed Carbon Steels.* **S. W. J. Smith, A. A. Dee and W. V. Mayneord.** (Phys. Soc., Proc. 37. pp. 1–14, Dec., 1924.)—In continuation of previous work [Abstract 1889 (1912)] which had been criticised [Abstract 1138 (1914)], further experiments are made on the reversal of magnetic moment which takes place in these steels above 180° C. The reversal does not occur when laminations are absent from the steel, and this property is applied as a test to determine whether a particular steel is in the laminated or granular condition. As regards carbon content, the reversed moment will probably be maximum in a steel which contains the eutectoid percentage of carbon; also the reversal is most pronounced in bars for which the dimension ratio has a value about 13. Curves are given to show the effect of the field intensity on the reversal; in the case of a composite bar of steel and iron, the residual moment of the iron became negative for fields greater than about 150 c.g.s. G. E. A.

**1217.** *A New Alloy of Iron and Nickel of High Magnetic Permeability.* **E. M. Deloraine.** (J. de Physique et le Radium, 6. pp. 20–28, Jan., 1925.)—Details are given of the physical properties of permalloy [see Abstract 2282 (1923)]. It is shown that the maximum initial permeability is obtained by cooling the alloy from a definite temperature at a predetermined rate. Mechanical strain, such as tension, compression, or torsion exerts a great influence on the magnetic properties. Impurities, carbon in particular, also affect the magnetic properties. Many applications of the alloy exist, and an important one is in submarine telegraphy. Winding permalloy tape round the copper coil increases the self-induction of the cable sufficiently to raise the speed of such telegraphy by five times. R. S. R.

**1218.** *Effect of Transverse Joints on Magnetic Induction in Nickel.* **S. R. Williams.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 109–

118, Jan., 1925.)—Maurain found that the magnetisation of the superficial layers of nickel is greater than that of the lower layers [Abstract 1372 (1902)]. N. H. Williams found that this held when the applied field was greater than about 25 c.g.s. [Abstract 1580 (1911)]. The author has studied the effect of a magnetic field on a group of plates suspended in a solenoid with their sections initially at 45° to the field. A bundle of plates behaved in small fields like a diamagnetic substance, and in strong fields like a paramagnetic; pressure caused the apparent diamagnetic property to disappear. When the air-gap was increased by paper, the group of plates always turned with their sections parallel to the field, no matter what pressure was applied. The results confirm those of N. H. Williams, and may be interpreted by the assumption that above a certain field strength the surfaces of narrow slits cut in nickel normal to the magnetising force are more susceptible than the interior layers. G. E. A.

**1219.** *Magnetic Properties of the Stable Forms of the Sesqui-oxides of Iron and Chromium.* **L. Blanc** and **G. Chaudron.** (Comptes Rendus, 180. pp. 289–291, Jan. 26, 1925.)—Experiments are carried out on oxides stabilised by heating above the point of incandescence [see Abstract 450 (1925)]. The magnetic susceptibility of oxide of Fe remains constant up to 600° C., where it decreases sharply, again increasing between 700° C. and about 900° C. The oxide of Cr gives constant readings up to about 800° C., where its susceptibility suddenly increases to a maximum, dropping from 900° C. to its original value at 1100° C. The figures for the densities of these oxides under various thermal conditions are recorded.

A. B. C. L.

**1220.** *Susceptibility of Rare Earths.* **S. Meyer.** (Phys. Zeits. 26. pp. 51–54, Jan. 1, 1925.)—In 1902 the author pointed out that a simple Mendeleeff period did not exist between the elements 57 to 72, but that a minimum was to be expected near the position of the elements 61 and 62 [Abstracts 890 (1902) and 492 (1903)]. In connection with the views of Bohr on the elements 57 to 72, measurements of susceptibility are given in conjunction with results by Cabrera. The combined results are expressed in magnetons, of which the number is given by $7 \cdot 58\sqrt{k \times 10^6}$, where $k$ is the susceptibility per mol. (or gramme/atom) per litre. A graph of magnetons against atomic number brings out a minimum, lying between atom No. 62 and 63. The arrangement of the electrons in orbits is tabulated for elements 57 to 60 and 70 to 72, and the author confirms Bohr's supposition that the extremes La (57) and Hf (72) are both diamagnetic.

G. E. A.

**1221.** *Department of Terrestrial Magnetism.* **L. A. Bauer** and **J. A. Fleming.** (Carnegie Inst. of Washington, Year Book No. 23. pp. 145–186, 1924.)

**1222.** *Terrestrial Magnetism and Electricity at the Madrid Meeting, October, 1924.* **L. A. Bauer.** (Internat. Geodet. and Geophys. Union, Bull. No. 4. [10 pp.], Dec., 1924.)—General report embodying the resolutions adopted at the Madrid meeting by the International Section of Terrestrial Magnetism and Electricity and including a questionnaire issued in connection with a systematic investigation of the sudden commencement of magnetic storms. R. S. R.

## CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

**1223.** *Adsorption.* **F. Schelte.** (Zeits. phys. Chem. 114. pp. 394–412, Jan. 20, 1925.)—Adsorption isotherms are given for various dyestuffs and for powders of an ordinary window glass and of Jena glass. The curves show the usual shape, indicating considerable increase of the adsorption with the concentration to a state of saturation. The extent to which the surface is covered by the colouring matters is widely different for the two types of glass, being 192–198 % for the window glass and 75–192 % for Jena glass; hence the results obtained with different glasses are valueless as indications of the extent of covering of the surface, this depending also on the chemical composition and physical properties of the adsorbing material. T. H. P.

**1224.** *Studies in the Adsorption from Solution from the Standpoint of Capillarity.* **W. A. Patrick** and **D. C. Jones.** (Zeits. phys. Chem. 29. pp. 1–10, Jan., 1925.)—The adsorption from solution by silica gel is investigated in the following systems: Formic acid, acetic and butyric acid in a series of solvents; nitrobenzene and benzene from kerosene; benzoic acid and iodine from a series of solvents; and acetic acid from carbon disulphide throughout the entire range of concentration. The relation between the solubility of liquids in one another and the curvature between the two liquids is considered. Curves are plotted to show the variation of solute adsorbed per gramme of silica gel for different equilibrium concentrations in the liquid phase. The petroleums which have the lowest surface tension are the solvents from which the greatest adsorption occurs, though in other cases the amount adsorbed from the solvents bears no relation to their surface tension. In general, adsorption of a solute increases as its solubility in the solvent decreases. It is concluded that in presence of the silica gel a liquid is adsorbed from solution in a second liquid by virtue of the capillary forces bringing about a phase separation. The preferential wetting which takes place is followed by the production of highly concave surfaces of solute, which brings about a lowering of the solubility of the solute in the solvent. The mechanism of adsorption is analogous to the case of a gas which is condensed in capillaries at pressures lower than the saturation pressure due to the presentation of highly concave surfaces of liquefied gas. J. N. P.

**1225.** *Studies in Adsorption from Solution from the Standpoint of Capillarity.* **W. A. Patrick** and **N. F. Eberman.** (J. Phys. Chem. 29. pp. 220–228, Feb., 1925.)—The adsorption of water from *n*-butyl alcohol by silica gel is investigated. An empirical formula analogous to that deduced for the adsorption of gases is applied to adsorption from solution in several cases in order to calculate the solubility. This is of the form $V = K(S\sigma/S_0)^{1/n}$ where V is the volume of solute adsorbed per gramme of gel, S is the equilibrium concentration of the solute in the surrounding solvent, K and $1/n$ are constants, $\sigma$ is the interfacial tension, and $S_0$ the solubility or "solution power" of the solvent. It is concluded that the surface tension of a liquid in a capillary tube is greater than that of the same liquid under ordinary conditions, and that the change is greater the higher the temperature. It is shown how the above variation affects the adsorption formulæ under consideration. J. N. P.

**1226.** *Absorption of Vapours by Carbon.* **E. Urbain.** (Comptes Rendus, 180. pp. 63–65, Jan. 5, 1925.)—The fact that one and the same sample of absorbent carbon is far more active towards certain vapours than towards others is attributed by the author to the "compactness" of the carbon, this denoting the ratio between the true and apparent volumes. If a weight P of well-dried carbon is soaked in a liquid of density $\delta$ and then weighs $P'$, the volume of the pores will be $v = (P' - P) \div \delta$; the actual volume of the carbon V may then be determined by weighing the soaked carbon in the liquid. In this way highly accurate results for the compactness are obtainable, even when different liquids are used in the determination. Investigation of the absorption of vapours of benzene, chlorine and chloropicrin by carbons of different compactness shows that the absorption of chlorine increases, and that of chloropicrin diminishes, as the compactness increases, whereas with benzene vapour the absorption is at a sharply defined maximum when the compactness has the value about 0·3. T. H. P.

**1227.** *The Adsorption of Nitrogen Peroxide by Silica Gel.* **R. C. Ray.** (J. Phys. Chem. 29. pp. 74–86, Jan., 1925.)—Reference is made to noteworthy instances of the selectivity of adsorption from liquids by charcoal and by silica gel which show that every theory of adsorption must take into account the operation of specific chemical or polar forces. The adsorption of nitrogen peroxide by silica gel is determined at different temperatures and pressures, and the results are given in tabulated form and are plotted as adsorption isotherms at different temperatures. It is found that within certain limits the water content of the gel exerts no influence on the amount of adsorption. Isotherms with gels containing 5·16 and 4·68 % of water lie practically on the same line. When the percentage of water in the gel falls to 3·27, however, the adsorptive capacity of the gel is considerably diminished, which is attributed to the reduction of adsorptive space caused by the heat treatment applied to remove the water, which leads to vitrification of the silica. It is found that by repeated adsorption the water in the gel is replaced by approximately the same volume of nitric acid, in accordance with the reaction $2N_2O_4 + H_2O = N_2O_3 + 2HNO_3$. The adsorptive capacity of the gel is only slightly diminished when the water is replaced by nitric acid. The adsorbed nitrogen peroxide can be removed from a gel containing nitric acid by drawing a current of hot and dry air through it. Of the several adsorption formulæ, the one by Freundlich, in which $x/m = ap^{1/n}$, where $x/m$ is the amount of gas adsorbed in unit mass of gel, is found the one most widely applicable, though it involves a separate determination of the constants for each temperature. J. N. P.

**1228.** *Activated Char for Gold Adsorption.* **R. H. McKee and P. M. Horton.** (Chem. and Met. Eng. 32. pp. 164–167, Jan. 26, 1925.)—The various theories of gold adsorption by carbon from cyanide solutions are discussed. The absorptive capacity of various samples of charcoal prepared by different methods was determined. It was shown that the black ash residues, an alkaline waste product from the soda pulp industry, can be treated so as to form an activated char of very great adsorbing powers. This material, when properly treated, is capable of adsorbing 2000 ozs. troy of gold per ton of char, and can replace zinc for precipitating gold from cyanide solutions. The purity of the bullion, obtained by use of the char, is much higher than that obtained by the use of zinc.

F. J. B.

**1229.** *Relation between Osmotic Pressure, Imbibition Pressure, and Adsorption.* **M. Polányi.** (Zeits. phys. Chem. 114. pp. 387–393, Jan. 20, 1925.)—The author has previously derived the following thermodynamic relation between the influence of dissolved substances on the osmotic pressure or imbibition pressure, on the one hand, and the fixation of such substances by crystalloids :

$$u = \frac{c}{\mathrm{RT}} \cdot \frac{d\pi}{dc}$$

$u$ being the amount of dissolved substance concentrated in the gel when in equilibrium with a solution, $c$ the concentration of the solution, and $\pi$ the imbibition (or osmotic) pressure of the colloid. The above expression is not suitable for experimental confirmation, but it is now shown that it can be converted into the form :—

$$c' - c - \left(\frac{dc'}{d\ln c}\right)_{c=\text{const.}} = \frac{c}{\mathrm{RT}} \cdot \frac{d\pi}{dc}$$

$c'$ being the concentration of the crystalloid in the chamber containing colloid, and $c$ that in the adjacent chamber free from colloid. An example from Loeb's work gives results in satisfactory accord with this expression.

T. H. P.

**1230.** *Removal of Gas Films.* **W. D. Bancroft.** (J. Phys. Chem. 29. pp. 20–33, Jan., 1925.)—Aitken [Roy. Soc., Proc. 51. p. 408, 1892] has shown that Rayleigh's experiment with impinging jets fails when hot water is used because the adsorption of air is insufficient at the higher temperature. Since a slight electrification at the ordinary temperature has the same effect as rise of temperature, it is probable that the electrical stress either decreases the amount of adsorbed gas or makes it easier to displace the adsorbed gas. Zeleny [Abstract 1641 (1920)] has shown that there is, on solids and liquids, a film of adsorbed gas which resists the passage of an electrical discharge from a point to the solid or liquid surface ; this result is in accord with that of Schuster's experiment on the arc at different pressures. The voltage necessary to displace the adsorbed gas film in Rayleigh's experiments is so small that the detection of any effect in Zeleny's experiments would not be expected. It seems probable that an adsorbed gas film becomes more sensitive to electrical stress when the arrangement is such that little or no free gas is present near the surfaces in question. Bailey [Abstract 208 (1923)] has shown that, even at low pressures, the copper oxide film on a copper wire adsorbs enough gas to increase the resistance of the wire perceptibly for high-frequency currents.

T. H. P.

**1231.** *Corrosion by Electrolyte Concentration Cells.* **R. J. McKay.** (Indust. and Engin. Chem. 17. pp. 23–24, Jan. 1, 1925.)—Corrosion of metals by concentration cells is held to be a common occurrence. The presence of oxygen in the corroding solution must be considered in any corrosion test which is to be made. When iron comes in contact with oxygen-bearing solution it reacts with the oxygen and water, forming ferric hydroxide. Where a mass of precipitate or other solid material is held in contact with the iron, the oxygen in the pores of the mass disappear in reacting with the iron. In the region surrounding the mass the oxygen is renewed by convection and diffusion, and hence an oxygen concentration cell is set up. The metal in contact with the higher concentration becomes the kathode, and that in contact with the lower oxygen content the anode. Iron goes into solution; a pit forms and deepens indefinitely. Experimental and other data are given in support of the theory. F. J. B.

1232. *The Solubility of Ferrous Hydroxide and its Effect upon Corrosion.* **W. G. Whitman, R. P. Russell** and **G. H. B. Davis.** (Am. Chem. Soc., J. 47. pp. 70–79, Jan., 1925.)—With a view to explain the effects of various salts upon the rate of corrosion of iron, the solubility of ferrous hydroxide is determined in water and in solutions of various concentrations of the following salts: sodium sulphate, calcium chloride, sodium chloride, ammonium chloride, magnesium chloride, sodium dichromate, sodium chromate, sodium silicate, and sodium hydroxide. The total solubility in conductivity water is determined by a colorimetric method to be $6 \cdot 7 \times 10^{-5}$ grm. mol. per litre, while the *p*H value of this solution is 9·6, or the hydroxyl ion concentration is $4 \times 10^{-5}$. From this it is seen that the ferrous ion concentration is $2 \times 10^{-5}$ and that the percentage ionisation is 30% and the dissociation constant $6 \cdot 8 \times 10^{-10}$ at 25° C. The value for this constant agrees with those determined from the solubility in sodium hydroxide solution. The free energy of formation of ferrous hydroxide has been calculated from the specific electrode potentials and the solubility to be − 57,200 cals. It is shown that the precipitation of colloidal ferric hydroxide in salt solution has apparently no direct connection with the rate of corrosion, and that the rate of corrosion in salt solutions is parallel to the solubility of ferrous hydroxide in these solutions. Measurements with chromates and dichromates show that in these solutions, which passify iron, iron hydroxides are practically insoluble. The high protectivity accompanying low solubility is attributed to film formation as hydroxide on the metal. [See Abstract 2855 (1924).] J. N. P.

1233. *Solubility of Bi-bivalent Salts in Solutions containing a Common Ion.* **O. J. Walker.** (Chem. Soc., J. 127. pp. 61–66, Jan., 1925.)—The solubility at 25° of succinates and malonates of calcium, strontium, and barium in solutions containing various concentrations of a common ion is in every case greater than would be predicted by the solubility product rule, the divergence being more marked the greater the solubility of the salt considered, and greater for an added bi-bivalent salt than for an added uni-bivalent salt. The data are examined from the point of view of the interionic attraction theory of ionised solutes as developed by Debye and Hückel, and especially, as regards solubility, by Noyes. The results are in good qualitative agreement with this theory, and, with the very sparingly soluble magnesium oxalate, a moderately good quantitative agreement is obtained. T. H. P.

1234. *The Solubility of Yttrium Salts.* **M. C. Crew, H. E. Steinert,** and **B. S. Hopkins.** (Univ. of Illinois Lab. Paper No. 17. J. Phys. Chem. 29. pp. 34–38, Jan., 1925.)—An investigation is made of the solubility in water of yttrium chloride, bromide, nitrate and sulphate. The yttrium material used was well fractionated and free from all known impurities except holmium and erbium. Solubility determinations were conducted by leaving the salt in contact with water in a flask mounted in a thermostat, and periodically shaken until complete equilibrium was obtained and carefully estimating the solution. Temperatures of from 0° to 95° C. were employed. The results obtained are recorded in the form of tables and curves showing the change of solubility with temperature. A determination of the temperature-pressure curve made on hydrated salts by means of a dilatometer indicate that no change occurs in the hydration of these salts between 25° and 95° C. J. N. P.

**1235.** *The Relation between Deviations from Raoult's Law and the Partial Heats of Solution.* **J. A. V. Butler.** (Am. Chem. Soc., J. 47. pp. 117–122, Jan., 1925.)—Most of the accurate measurements of the activity, $a$, and all those of the partial heats of solution in binary mixtures have been made for liquid metal mixtures from measurements of the e.m.f.'s of concentration cells. Cady has proposed an equation based on such measurements which may be written : $\log (a/N) = Q/RT$, where Q is the heat absorbed in the transfer of one mole of the component concerned from the standard state to a solution in which its mole fraction is N. Making use of the results of Richards and Daniels for thallium amalgam, it is found that, although the last equation does not hold, the equation $\log (a/N) = 0{\cdot}78\ Q/RT$ reproduces the observed values with an average error of 1·7 % for thallium and 2·6% for mercury. Similar results are obtained, using recent measurements by A. Taylor, for a number of pairs of liquid metals. It is shown that for a liquid in contact with its vapour, provided there is no heat effect in the passage of a molecule from the surface into the interior of the liquid, Cady's equation will hold. If, on the other hand, some heat is employed in the passage of molecules from the interior to the surface owing to complex formation (solvation or some such effect), $\log (a/N)$ will be less than Q/RT. For a linear relation the heat of solution may be divided between the passage from the interior to the surface and the escape from the surface in definite proportions for each system. H. N. A.

**1236.** *The Structure of Surface Films on Water.* **N. K. Adam.** (J. Phys. Chem. 29. pp. 87–101, Jan., 1925.)—A description is given of a modification of an apparatus devised by Langmuir in which a direct measurement is made of the force which acts on a surface film one molecule in thickness of an organic liquid on water. Curves are plotted to show the relation between the area per molecule and the compressive force on the film for a number of different substances. The effect of temperature on the nature of the compression curves is considered in detail. There is a strong attraction between such groups as $-\mathrm{OH}$, $-\mathrm{COOH}$, $-\mathrm{COOCH_3}$, $-\mathrm{CN}$, etc., and water. The properties are considered in relation to melting-points and to the structure of crystals. An explanation is provided of the tendency of the salts of the higher fatty acids to form colloidal ions of high molecular weight and mobility and to suggest a possible structure for these micelles. The conditions affecting the disposition of a liquid such as soap at the interface between liquids in emulsions are discussed and a theory is put forward for the detergent action of soap. According to this, in a solution of soap, the soap molecules will be absorbed on the surface with their hydrocarbon ends to the dirt, and their water-attracting ends to the water. Hence the surface of the particle is rendered strongly water attracting, and, if the particle is small enough, it will go into colloidal solution. [See Abstract 185 (1924).] J. N. P.

**1237.** *The Ultra-Centrifuge, a New Instrument for the Determination of Size and Distribution of Size of Particles in Amicroscopic Colloids.* **T. Svedberg and H. Rinde.** (Am. Chem. Soc., J. 46. pp. 2677–2693, Dec., 1924.)—An instrument which is devised and termed the "ultra-centrifuge" enables a determination to be made of the variation of concentration in the sol as a function of the distance from the axis of rotation during centrifuging. The method is based on light absorption and involves the recording of photographs of the sol while in the centrifuge at various intervals of time by means of a self-registering microphotometer. Curves are then constructed giving the relation between the concentration of the sol and the distance from the meniscus and from the axis of rotation. The theory of the methods for determining the size and the distribution of size of the particle from observations of the sol during centrifuging is further developed. Results of measurements of the size and distribution of gold sols of average radius from $2{\cdot}3\,\mu\mu$ to $11{\cdot}6\,\mu\mu$ are given. The determinations made by the ultra-centrifuge give radius values which are from 11 to 38% higher than those arrived at by means of Zsigmondy's method. [See Abstract 1680 (1923.] J. N. P.

**1238.** *A New Method for the Determination of the Distribution of Size of Particles in Emulsions.* **E. O. Kraemer** and **A. J. Stamm.** (Am. Chem. Soc., J. 46. pp. 2709–2718, Dec., 1924.)—A method for determining the distribution of the size of particles in emulsions with a rising disperse phase is developed and consists in observing the rate of change in the apparent density of the upper portion of an emulsion into which the disperse phase is rising. The distribution curve is derived from the time-concentration curve so obtained by the method of Svedberg. In the emulsions employed, consisting of 10% benzene in water, it is shown that the distribution curves can be closely reproduced for two emulsions prepared under the same conditions. The position of the maxima in the distribution curves is found to be but slightly changed by changes in the concentration of the emulsion. Measurements are made of the influence of different stabilisers and of homogenisation under different conditions. J. N. P.

**1239.** *The Significance of Röntgen Spectrography in Swelling Phenomena.* **J. R. Katz.** (Phys. Zeits. 25. pp. 659–666, Dec. 15, 1924.)—A review is given of existing information on the nature of swelling on absorption of a liquid which occurs with biological products such as wood, fibres, threads and gelatin. The analogy with solution in the relation between volume contraction and heat evolution is pointed out. The application of Röntgen spectrography has enabled the phenomena to be investigated from new aspects. As formerly described [Abstract 520 and 951 (1925)] a distinction between the cases where liquid is absorbed between individual molecules and larger aggregates or micelles can be recognised provided that certain conditions are fulfilled. The component which gives the Röntgen interference must be the one which swells. The Röntgenographical identity period must be at least as great as the size of the molecule. The criterion of intramolecular swelling is that the increase of the lattice on absorption of liquid is proportional to, and of the same order of magnitude as the increase in the visible dimensions of the body. In cases where the micelles are parallel to the axes of a bundle of threads, a so-called thread or four-point diagram is given. If, on absorption of water, the arrangement of the micelles is destroyed the diagram changes to that of the Debye-Scherrer rings. A description is given of the characteristic results obtained with ramie fibres and substances of the starch group in different solutions. In the case of colloidal gold, and in other instances, the breaking-down of the micelles into smaller ones can be followed and an estimate made of the size of the crystallites. J. N. P.

**1240.** *Periodic Precipitation in Dilute Gelatine Gels.* **G. W. S. Blair.** (Phil. Mag. 49. pp. 90–96, Jan., 1925.)—Liesegang discovered that when the solution of one salt diffuses into a jelly containing another salt with which the first interacts to give a sparingly soluble compound, the precipitate formed is in many cases in separate rings instead of a continuous band. Liesegang suspected, what the author proves, that the age of the gels profoundly influences the ring formation in them. Solutions of $AgNO_3$ were tested with solutions of $K_2Cr_2O_7$ and $K_2CrO_4$. Increasing the strength of gelatine decreased the age limit of the ring formation. The effect of light of various wave-lengths was investigated and a fundamental difference found between the effects of ultra violet and ordinary light. A new modification of Ostwald's theory of the phenomenon is discussed and evidence in its favour put forward. R. S. R.

**1241.** *Volume Changes of Alloys during Solidification.* **H. Endô.** (Tôhoku Univ., Sci. Reports, 13. pp. 219–227, Nov., 1924. In English. Eighty-ninth report from the Research Inst. for Iron, Steel and other Metals.)—Gives the results of measurements of change of volume during melting or solidification of six alloys by method previously described [see Abstract 1368 (1924)] as follows: Silumin, Al 87·5, Si 12·0, Fe 0·5; 3·47%. Aluminium-copper, Al 67·0; 4·81%. Duralumin, Al 92·5, Cu 4·4, Mg 1·5, Si 0·5; 5·06%. Copper-aluminium, Cu 87·0; 4·27%. Copper-tin, Cu 62·0; 3·57%. Copper-zinc, Cu 60·6; 2·89%. C. O. B.

**1242.** *Solidification of Ternary Alloys Al-Mg-Cd.* **J. Valentin** and **G. Chaudron.** (Comptes Rendus, 180. pp. 61–63, Jan. 5, 1925.)—The methods used for studying this system were those previously described [Abstract 590 (1923)]. Three curves of secondary eutectic deposits intersect at the ternary eutectic point 395°. The results are given diagrammatically. T. H. P.

**1243.** *Distribution of Graphite in Cast Iron and Influence of Elements on Its Strength.* **M. Hamasumi.** (Tôhoku Univ., Sci. Reports, 13. pp. 133–178, Nov., 1924. In English. Eighty-sixth report from the Research Inst. for Iron, Steel and other Metals.)—The strength of cast iron increases considerably with the cooling velocity, the result being principally attributed to the more uniform distribution and curved nature of the graphite. The nature of the graphite is greatly influenced by the rate of cooling. The mechanism of the growth of graphite, especially "whirling graphite" and the cause of black fractures in iron castings are discussed. The strength of cast iron rapidly decreases with increases of carbon over 2%. Additions of silicon render cast iron weak by reducing the amount of combined carbon. Phosphorus stiffens cast iron up to 0·3 %; a further addition should be avoided in machine castings. The presence of 1 to 3% of P. favours the decomposition of cementite and above 3 % an increase of combined carbon is observed. Sulphur strengthens cast iron up to 0·1 %, and to this amount is not detrimental. Manganese up to 3 % does not make cast iron brittle; the amount of graphite is not affected by manganese in the presence of 2 % Si. Copper up to 1 % strengthens cast iron, a further addition, up to 4 %, has no further effect on the strength and does not affect the graphitisation. About 0·4 % Cr is very favourable for castings that require a great strength. Up to 2 % tin does not affect the strength of cast iron, but further additions render it brittle. C. O. B.

**1244.** *Action of Iron on Copper at High Temperatures.* **P. Siebe.** (Zeits. f. Metallkunde, 17. pp. 19–21, Jan., 1925.)—Foundrymen avoid bringing iron and copper into direct contact at high temperatures because the copper may become deteriorated. According to the author the effect is due to the reduction by the hydrogen and carbon monoxide evolved from the hot iron of the cuprous oxide in the copper. He experimented with electrolytic or refined copper containing up to 0·28 % of oxygen and low carbon steels. Oxidised copper sheets and wires became less ductile by contact with the hot iron (above 600°), whilst deoxidised copper was not affected. H. B.

**1245.** *The Passive State of Metals.* **E. Becker** and **H. Hilberg.** (Zeits. Elektrochem. 31. pp. 31–40, Jan., 1925.)—The passivity and activity of a number of metals were examined in a number of solvents; measurements were made of the " contact distance " of active and passive metals, this being the minute distance by which a contact could be separated while still allowing a current to flow; the photoelectric effect was also measured with active and passive metals. The authoresses conclude that absorbed gases have a large and perhaps a conclusive influence on the Hallwachs photoelectric effect, and also on the activity and passivity of metals; but no direct connection can be proved, as is shown clearly by the experiments with chromium; this metal shows small photoelectric sensitiveness when in the passive state, and this sensitiveness is not altered by scraping, though this produces chemical activation. The magnitude of the contact distance of different metals does not distinguish active from passive ones, and even with the same metal it is impossible by this means to distinguish certainly between the active and passive states. The optical constants, and the potential values, are not certain signs of the active or passive condition of a metal. The only certain criteria are the velocity of reaction, or the behaviour of the metal in relation to Faraday's law, which holds only for the active state. H. N. A.

**1246.** *Kinetic Studies of Solid Metals. Decay of* $Al_2Zn_3$. **W. Fraenkel** and **W. Goez.** (Zeits. f. Metallkunde, 17. pp. 12–17, Jan., 1925.)—The authors and Heymann have continued Stäblein's kinetic studies of the change in the electric resistance of steel with the combined carbon content [Abstract 970 (1924)], investigated the transition of monoclinic into rhombic sulphur by means of an air dilalometer, and are studying the decay of the alloy $Al_2Zn_3$ which is unstable below 256°. The change is accompanied by a contraction and by heat evolution [see Hanson and Gaylor, Abstract 2160 (1922)]. The authors use both these methods at or near 0°, and find in both cases that, as in radio-active decay, the rate of decay is constant. The specimen, annealed at 400°, is quenched in ice water which alone answered, although the water attacks the alloy under gas evolution; in the other quenching media (alcohol, ether-carbon dioxide, liquid air) the specimen remained warm. The dilatometer liquid used is aniline. In the special calorimeter the specimen is placed within a vertical wire-gauze cylinder acting as stirrer (raised twice per second) of the benzene contained in a Dewar vessel carefully insulated. An experiment may take several hours, during which the specimen is quenched, placed in the calorimeter, quenched again and so on. Thus it was possible to measure the heat of the monomolecular reaction under fairly isothermal conditions, though most of the hundreds of experiments had to be abandoned. H. B.

**1247.** *Metallurgy and Physical Research.* **J. Czochralski.** (Zeits. f. Metallkunde, 17. pp. 1–11, Jan., 1925.)—A lecture on the strength of metals, stress-strain phenomena, cold work, single crystals, and their distortion, X-ray studies and the flow of metals from the standpoint of a dislocation of the atoms in the space-lattice. [See Abstract 2035 (1923).] H. B.

**1248.** *The Trend in Physical Metallurgy.* **C. H. Mathewson.** (Frank. Inst., J. 199. pp. 37–50, Jan., 1925.)—A general review of the subject largely devoted to the methods of studying the space lattices of alloys by means of X-rays. Mention is made of recent work dealing with the allotopy of zinc, the conclusion being that if any change in the structure takes place over the range up to 330° C. it must be of the most trifling character. Reference is also made to the investigation, again by the X-ray method, to the fragmentation and distortion of the crystals which result from cold work. A. A. D.

**1249.** *Effect of Cold-rolling on Hardness of Copper.* **H. Moore.** (Inst. of Metals, J. 32. pp. 407–409; Disc. and Corres., 409–414, 1924.)—Discontinuities in the rate of hardening of copper by progressive cold-working have been observed by Alkins, Johnson [see Abstract 151 (1921)] and others, and Rawdon and Mutchler have stated that the Brinell hardness of copper, iron, tin and other metals and alloys rose rapidly during the initial stages of deformation and then diminished; "the metal becomes softer, and in its final form may be softer than the metal in its initial stage." Such conclusions appear so contrary to common experience that experimental confirmation was sought. A prepared bar of copper was rolled from 3·12 in. thickness to 0·0125 in., one half of the material being withdrawn for testing after each 50% reduction. Brinell hardness determinations were made in dead load machines. The results show that increases take place throughout the series from 48 for the original annealed copper to 130 for the final specimen. It is suggested that the heat developed during rolling in some of the previously published results was sufficient to bring about a marked annealing effect. In the *Correspondence,* **K. Honda** points out that as a result of cold working the hardness increases at first rapidly and then slowly, tending to an asymptotic value; he also suggests a possible explanation of the phenomenon of hardening by cold work. C. O. B.

**1250.** *Recent Developments in Non-Ferrous Metallurgy in the United States, with Special Reference to Nickel and Aluminium-Bronze.* **W. M.**

**Corse.** (Inst. of Metals, J. 32. pp. 455–474, 1924.)—A comprehensive survey is given of the history, occurrence, smelting and refining properties, and commercial uses of Ni and the principal alloys into which it enters as an essential constituent. A. B. C. L.

**1251.** *Sodium in Aluminium.* **D. M. Fairlie** and **G. B. Brook.** (Inst. of Metals, J. 32. pp. 283–289; Disc. and Corres., 289–290, 1924.)—Sodium always has appeared among the constituents specified by Government departments as not allowable beyond a trace (0·05 %, afterwards reduced to 0·03 %). Processes hitherto available for the analysis have been unsatisfactory, and the authors have worked out a method based on the separation of aluminium as nitrate from 70 % nitric acid, the sodium being finally converted into and weighed as sulphate. Results obtained indicate that ordinary ingot metal representing present commercial production contains from 0·001 to 0·008 % sodium. Metal known to have been made under abnormal conditions gave 0·014 to 0·042 %, and examination of a series of alloys containing 90 % Al gave results varying from 0·003 to 0·06 %. Of 27 samples examined, only 5 gave results above the 0·03 limit. C. O. B.

**1252.** *Metal Cleansing with Alkaline Cleaning Solutions.* **E. M. Baker** and **R. Schneidewind.** (Am. Electrochem. Soc., Trans. 45. pp. 327–352, 1924.)—A description is given of the methods investigated for the preparation of metal surfaces by the use of alkaline solutions for the purposes of electroplating and japanning. By the application of an observation made by Donnan that the cleaning power of a substance is proportional to its power of emulsification with the substance to be removed, a method is applied for judging the efficiency of alkaline cleaning solutions by measurement of the relative interfacial tension of water and these solutions with a standard mineral oil. These measurements indicate soaps, sodium hydroxide, phosphate, carbonate, and silicate to be the most effective components of alkaline cleaners. The cleaner should be kept at as high a temperature as possible and agitation of the solution is desirable. The use of direct electric current is an aid to cleansing, but is not very effective if the current density is less than 10 amps. per sq. ft. of surface to be cleaned. Generally it is preferable to make the work the kathode, though there are exceptions to this rule. J. N. P.

**1253.** *The Dissipation of the Heat of Reaction.* **M. Born** and **J. Franck.** (Ann. d. Physik, 76. 2–3. pp. 225–230, Jan., 1925.)—Two of the possibilities are discussed in recent literature as to the manner in which the liberated energy (heat of reaction) is disposed of when two atoms unite to form a molecule, *viz.*: (1) a triple impact in which a third non-participating atom within the zone of collision acquires translational energy [see Abstract 1203 (1922)]; (2) the assumption of radiant energy emission in the form of light. Both conceptions are based on the impossibility of the energy content of a molecule exceeding the work of dissociation, the validity of which is now questioned. The triple impact conception is also found necessary on other grounds, and the authors attempt to show when triple impacts are the cause of dissipation and when radiation has to be assumed. H. H. Ho.

**1254.** *Union of Hydrogen and Oxygen in Presence of Silver and Gold.* **D. L. Chapman, J. E. Ramsbottom** and **C. G. Trotman.** (Roy. Soc., Proc. 107. pp. 92–100, Jan. 1, 1925.)—The experimental results here described indicate that, when silver is heated to dull redness in oxygen at a pressure exceeding 0·005 mm. of mercury, it becomes almost completely covered with a film of oxide, which considerably impairs the efficiency of the metal as a catalyst for the reaction between hydrogen and oxygen. This film of oxide may be removed by heating the metal to redness either in a vacuum or in oxygen at a much lower pressure. The catalytic activity of the metal is then the same as that of silver which has been heated in hydrogen. These considerations furnish a consistent explanation of the discovery of Bone and Wheeler that silver, after being heated in hydrogen, becomes a much more efficient catalyst for the interaction of hydrogen and oxygen than silver not so treated, the latter being covered with the film of oxide. The behaviour of gold is similar to, but not so pronounced as, that of silver. The film of silver condensed on the inner surface of the vessel in which the silver filament had been repeatedly heated was found sufficient to cause union of hydrogen and oxygen at the ordinary temperature.

T. H. P.

**1255.** *Displacement of Alkaline Metals by Iron.* **L. Hackspill and R. Grandadam.** (Comptes Rendus, 180. pp. 68–70, Jan. 5, 1925.)—In a previous paper (*ibid.*, 179. p. 464, 1924) the authors have proposed the following equation for the reaction between sodium or potassium chlorides and iron at temperatures above 800° C.:

$$Fe + 2MCl \rightleftharpoons FeCl_2 + 2M \ (-\ 115 \cdot 9 \text{ cals. for KCl}).$$

To test this formula it is necessary to prove the existence of the free alkali metal M. Methods of doing this are described and similar reactions between alkali carbonates, sulphates and hydrates with iron are considered. In every case it is shown that the alkali metal results from the reaction.

A. B. W.

**1256.** *The du Pont Process for Manufacture of Cyanides.* **H. G. Chickering.** (Chem. and Met. Eng. 31. pp. 967–970, Dec. 22, 1924.)—The du Pont Company in 1918 commenced to investigate the subject of nitrogen fixation for the production of cyanides, as a step to the manufacture of ammonia and nitric acid, both of which are consumed in large quantities in the manufacture of explosives. It was discovered that pure nitrogen was entirely unnecessary, and that with producer gas as the source of the nitrogen, substantially the same amount of cyanide was formed in a given time and at the usual temperature, provided two important precautions were observed: (*a*) The producer gas must have a minimum $CO_2$ content (not more than 6 % by volume), and (*b*) any cooling down of the cyanised charge in presence of producer gas must be avoided. The use of metallurgical coke was found to have disadvantages due to its high ash-content and low activity, and research led ultimately to the employment of the by-product carbon produced in the preparation of wood-pulp for the manufacture of paper by the soda process. This by-product carbon, when substituted for metallurgical coke in charges otherwise of the same composition and furnaced under the same conditions, gave a substantial increase in the conversion of soda ash to cyanide; an average of from 40 % to 45 % cyanide in the furnace product, as against a previous average of 35 %; a shortening of two hours in the time required for the complete cyanide reaction, when oxide of iron and an alkali halide were used as catalysers. J. B. C. K.

1257. *Influence of a Magnetic Field on Certain Chemical Reactions.* **M. A. Parker and H. P. Armes.** (Roy. Soc. Canada, Trans. 18. Sect. 3. pp. 203–207, 1924.)—When the solutions are not stirred, the reduction of potassium permanganate by iron in presence of sulphuric acid, and that of ferric chloride by metallic iron or aluminium in presence of hydrochloric acid, are accelerated by the influence of a magnetic field. The effect of stirring the liquids during the reduction diminishes the increase in the extent of the reduction produced by the field, but it is still uncertain whether the difference disappears with increase in the rapidity of stirring. The observed effect of a magnetic field on the reduction of ferric chloride by magnesium in hydrochloric acid solutions of certain concentrations is attributed to the formation of a magnetic deposit on the surface of the magnesium. T. H. P.

1258. *Mechanism of Setting of Calcium Sulphate Cements.* **C. L. Haddon.** (Faraday Soc., Trans. 20. pp. 337–341, Dec., 1924.)—Various theories which have been advanced to explain the mechanism of the setting of calcium sulphate cements are discussed and evidence is quoted to show that fundamental differences exist in the hydration processes between plaster of Paris, flooring plaster, and anhydrite. The setting phenomena are not explicable by assuming that a precisely similar process takes place in each case, although at varying speeds. Moreover, catalysts have not the same effect in the three cases. Thus, the hydration of flooring plaster and anhydrite is accelerated best by other sulphates, whereas with plaster of Paris the effect of potassium sulphate is no greater than that of potassium chloride in equivalent concentration. The fact that the weaker the cement during setting the greater is the expansion supports Desch's view that the expansion is due to crystal thrust, and an extension of this theory is made in order to explain differences of expansion in different materials. Similarities are pointed out between the coherence of calcium sulphate cements and that of metals. The absence of such coherence when anhydrite undergoes hydration seems to indicate that the inter-crystalline film is formed under special conditions when circumstances do not allow of the growth of perfect monoclinic crystals, and irregularly-shaped crystals meet. T. H. P.

1259. *So-called Poisoning of Oxidising Catalysts.* **C. Moureu and C. Dufraisse.** (Chem. Soc., J. 127. pp. 1–4, Jan., 1925.)—The fact that the combustion of hydrogen in oxygen is prevented by certain combustible gases, such as ethylene, not only when the combustion takes place under the influence of finely divided platinum but also when an electric spark is used to effect the combination, renders it probable that the preventing mechanism is similar in the two cases and seems to rule out the "poisoning" theory advanced to explain these and analogous phenomena. Such hindrance to oxidation may, however, be explained by the authors' theory, according to which small proportions of certain "anti-oxygenic" compounds are able to prevent the autoxidation of autoxidisable substances; compounds having one or more phenolic hydroxyl groups always exert this influence on many autoxidisable substances, sometimes to a very marked degree. This theory, which is discussed in detail, is supported by the fact that the gases indicated as having this hindering action are, without exception, oxidisable. T. H. P.

**1260.** *Mechanism of the Inhibition of the Catalytic Action of Platinum Black and Partially Reduced Nickel Oxide by Chlorine.* **M. C. Boswell** and **C. H. Bayley.** (J. Phys. Chem. 29. pp. 11–19, Jan., 1925.)—The results of experiments on the poisoning of nickel and platinum catalysts by chlorine seem to indicate that the poisoning is accomplished by the destruction of the surface film on the catalytic particles, this film being the seat of the normal catalytic action. The destruction of the film renders possible the access of free hydrogen to, and hence rapid removal of, the internal oxygen which is of vital importance to the maintenance of the surface film and hence of the catalytic action. The results are interpretable on the basis of the theory of the mechanism of catalytic action already advanced. [Roy. Soc. Canada, Proc. 17. p. 1, 1923.] T. H. P.

**1261.** *Concentration Cells in Methyl Alcohol.* **J. Grant.** (Faraday Soc., Trans., 20. pp. 385–390; Disc., 391, Dec., 1924.)—This paper describes a method of measuring the transportation number by determining the electromotive forces of concentration cells made up of solutions of tetraethylammonium iodide of different strengths. The method used was an adaption of the method previously described, measurements to the nearest 0·1 millivolt being possible. In general the values obtained by this method are lower than those given by Carrara for corresponding dilutions. The maximum value of the transport-number for the cation of solutions of tetraethyl ammonium iodide in methyl alcohol is about 0·280. [See Abstract 1326 (1924).] F. S. B.

**1262.** *Effect of Superposed Alternating Current on the Polarisable Primary Cell Zinc-Sulphuric Acid-Carbon. Part I. Low-frequency Currents.* **A. J. Allmand** and **V. S. Pari.** (Roy. Soc., Proc. 107. pp. 126–137, Jan. 1, 1925.)—The depolarising effects of alternating current on the zinc/sulphuric acid/carbon cell was investigated. Alternating current, varying from frequencies of 5 to 500 cycles per second was employed. The changes in polarisation at the zinc and carbon electrodes was determined, and it was found that, with the frequencies employed, the chief effect of the alternating current is confined to the carbon electrodes. Low frequencies produce bigger effects than higher frequencies. The change in potential of the zinc electrode is in the direction of depolarisation. When the current delivery of the cell was kept constant at 0·010 amp., and the frequencies of 20 and 400 employed, the p.d. of the carbon electrode varied from + 0·130 to 0·445 volt at 20 frequencies and from + 0·006 to 0·280 volt at 400°. F. J. B.

**1263.** *Electro-Endosmosis. Part I.* **F. Fairbrother** and **H. Mastin.** (Chem. Soc., J. 125. pp. 2319–2330, Nov., 1924.)—Previous work on the subject by various investigators is reviewed and it is concluded that, regarding porous diaphragms as equivalent to a bundle of fine capillary tubes (Helmholtz' suggestion), the calculation of the potential gradient along the walls of the capillaries, which is the driving force of the electro-endosmosis by Ohm's law, from the current flowing through the diaphragm and the resistance of the electrolyte, involves unsatisfactory assumptions. A detailed description, together with an account of elaborate precautions taken to purify materials and to cleanse apparatus, is given of a series of experiments in which carborundum (100-mesh) constitutes the porous diaphragm and KCl and NaHO solutions the electrolytes. Measurements are obtained of electro-endosmosis through the diaphragm with the simultaneous measurement of the potential gradient across the diaphragm. The ratio of the effective cross-section to the effective length of the diaphragm is also measured electrically. The electrokinetic potential, calculated from a modification of the Helmholtz equation, reaches a maximum in dilute alkali, decreasing in more concentrated alkaline solutions and in acid solutions, the carborundum being negatively charged with respect to the water. In the equation $u = qE\zeta\epsilon/4\pi\eta l$, where $u$ is amount of liquid transported in unit time, $l$ and $q$ respectively the length and cross-section of the tube, E the total fall in potential between the ends of the tube, $\eta$ the viscosity coefficient of the liquid, $\epsilon$ the dielectric constant, and $\zeta$ is the potential between the two parts of the double layer, the value $-0{\cdot}0698$ volts is adopted as the value for $\zeta$ in distilled water. Contrary to the experience of other workers, carborundum does not exhibit any reversal of the direction of electro-endosmosis in HCl solutions up to N/50 strength. A. B. C. L.

**1264.** *Electro-Endosmosis.* **F. Fairbrother.** (Chem. Soc., J. 125. pp. 2495–2501, Dec., 1924.)—In continuation of previous work [see preceding Abstract] experiments are devised to show that the calculation of the potential gradient, in electro-endosmosis, from observed current-flow and the resistance of the electrolyte is inadvisable on account of surface effects. The apparent conductivities of electrolytes including dilute solutions of KCl, HCl, sulphosalicylic acid, $H_2SO_4$, acetic acid, $AlCl_3$ in powdered Jena glass and carborundum are measured. Electrolytes in Jena glass powder show an increased conductivity of several units %, the increase being greatest in dilute solutions and least (in the present paper assumed negligible) in solutions of strong acids. The alternating-current resistance of carborundum-electrolyte mixtures depends on the conductivity of the electrolyte, the resistance of the latter becoming, with very dilute solutions, of the same order as that of the carborundum. A. B. C. L.

**1265.** *Electrolysis of Potassium Oxalate with Tin Anode.* **F. H. Jeffery.** (Faraday Soc., Trans. 20. pp. 392–401, Dec., 1924.)—This paper describes an investigation of the effects of the passage of an electric current from a tin anode to aqueous solutions of potassium oxalate. A Darwin thread recorder was used to give a time integral of the current, it was calibrated by reference to a standard ammeter which was included in the circuit. The results obtained do not appear to be in agreement with the generalisation of Meyer-Jacobson (Lehrbruch der organischen Chemie, Leipzig, 1913). The original paper should be consulted by those specially interested. F. S. B.

**1266.** *Formation of Perborates by Electrolysis with Unsymmetrical Alternating Current.* **S. Bodforss** and **A. Arstal.** (Zeits. Elektrochem. 31. pp. 1–5, Jan., 1925.)—Hydrogen peroxide is only formed in very small quantities when direct-current electrolysis is employed, but with alternating current a fair current yield is obtained. A solution of 5 mols. sodium hydrate and 1 mol. boric acid per litre was electrolysed with alternating current of 48 periods, between zinc electrodes at a temperature of + 1° C. The electrical circuits were arranged so that unsymmetrical alternating current was obtained in the electrolytic cell. The influence of current density and time upon the formation of peroxide acid oxygen was determined. The ratio between direct and alternating current and its effect upon the yield was investigated, and the yield of $H_2O_2$ with varying composition of the electrolyte was followed. It was found that in order to obtain perborate the alternating current must be greater than the direct current. F. J. B.

**1267.** *Theory of Concentrated Aqueous Solutions of Strong Electrolytes.* **E. Hückel.** (Phys. Zeits. 26. pp. 93–147, Jan. 15, 1925.)—In continuation of previous researches by Debye and the author [Abstracts 2541 (1923) and 1631 (1924)] the author points out that, owing to electric induction, neutral particles are generally attracted by electrically charged bodies, but that in a medium like water, which has a high dielectric constant and the molecules of which are electric dipoles, repulsion will result. Simple ions are not dipoles, but they are not merely rigid spheres either; they can be deformed and are hence also polarisable, though less so than the water. Thus repulsive forces arise in addition to the attractive Coulomb forces when two ions approach one another in water, and the additional forces may predominate and raise the activity coefficient above unit value. Hence also hydration of the ions which retain an atmosphere of water more easily than one of similar ions. Factors in these relations are the electric moment, the volume of the ion and its water of hydration and the dielectric constant. Quite close to the ion the field intensity may be so enormous that the dipoles are completely oriented and the water becomes electrically saturated. Herweg [Abstract 715 (1921)] observed indeed a lowering of the dielectric constant of water in strong electric fields. In comparing the theoretical deductions with the experimental data chiefly of e.m.f. measurements of galvanic cells (taken mostly from American experimenters and Walden), the author confirms that the dielectric constants of aqueous solutions of NaCl, KCl, LiCl decrease as the concentrations and activity coefficients increase; but the accord is hardly satisfactory. The accord is better for HCl; in that case the $H^+$ ions may exist free (not hydrated) or as $H_3O^+$ (hydrated) ions; the activity measurements leave the question undecided and are not decisive as to the influence of the additions of the salts mentioned to HCl. So far only monovalent ions have been studied though the theory is not restricted to them. H. B.

**1268.** *The Behaviour of Electrodes of Platinum and Platinum Alloys in Electrometric Analysis.* (1) *Dissimilar Electrodes.* **R. G. van Name** and **F. Fenwick.** (Am. Chem. Soc., J. 47. pp. 9–19, Jan., 1925.)—The potential difference between two inert electrodes near the end-point of an oxidimetric titration is primarily a time effect due to a difference in the rate at which the dissimilar electrodes approach equilibrium with a solution of changing composition. Since the electrode potential is of the form E = const. X log $x/1 - x$ ($x$ representing the fraction of the active agent which is at the higher state of oxidation and $1 - x$ that in the lower), its value will be exceedingly sensitive to slight changes in $x$ when the latter approaches its limiting values 0 and 1. In the actual titration, on account of an appreciable lag in the electrode potentials its amount will tend to be different at the two dissimilar electrodes and the divergence so produced will obviously be greatest in the region of sensitivity referred to. This effect is in fact observed in most cases at the end point. The electrodes employed are pure Pt and Pt Rh thermocouple wire, and the reactions investigated are the titration of ferrous iron with permanganate and with dichromate and of thiosulphate with iodine. The p.d.'s always tend to disappear with time. With different platinum alloys the relation between time and p.d. depends greatly on the nature of the alloying metal, but the phenomenon is not sufficiently specific to serve as a test for the nature or amount of small percentages of impurity. [See Abstract 409 (1923).]

J. N. P.

**1269.** *Electrolysis with Mercury Drop Kathode.* **J. Heyrovský.** (Comptes Rendus, 179. pp. 1044–1046, Nov. 17, 1924.)—Results of experiments carried out in a simple Hg drop kathode, Hg layer anode electrolytic cell, on various dilute and very dilute solutions of salts of K, Fe, In, Li, Tl, Pb, Na, Cd, and Bi, are represented graphically taking intensities of polarisation current as ordinates and potentials imposed on the kathode as abscissæ. The theoretical relationship $\pi = RT/nF \log_e c$, ($\pi$ = kathode potential, C = concentration of metal on the surface of the drop, $n$ = valency, $c$ = concentration of metallic ions in the electrolyte, K = a constant characteristic of the metal, and R, T, F, having the usual significations) is established. The effects of the residual current due to reducible impurities are minimised by passing a stream of H through the apparatus prior to electrolysis. A method is indicated, based on the foregoing studies, by which very minute traces of several metals may be qualitatively and quantitatively detected. A. B. C. L.

**1270.** *The Measurement of Hydrogen-ion Concentration.* **E. B. R. Prideaux.** (Journ. Sci. Instruments, 1. pp. 33–38, Nov., 1924, and 2. pp. 113–118, Jan., 1925.)—After a brief summary of the methods which have been used for determining hydrion concentration, the scopes of the conductivity and the hydrogen electrode methods are defined, and the latter is described in detail. The theory of the hydrogen electrode is based on the equilibria at a surface between a noble metal, preferably platinum, and hydrogen in various forms. The reproducibility of such electrodes is good. The equations connecting e.m.f. and hydrion concentrations are then stated. The potentials of the chief standard pairs of cells are tabulated and the corrections for alteration in hydrogen pressure are noted. The experimental manipulation is described under the headings: electrodes, cells, potentiometers, and null point indicators. A brief survey is then made of the applicability of the method to different solutions. AUTHOR.

**1271.** *Current-Voltage Curves for Nickel and Aluminium.* **E. Liebreich and W. Wiederholt.** (Zeits. Elektrochem. 31. pp. 6–15, Jan., 1925.)—The current-voltage curves for nickel and aluminium have been studied both for anodic and kathodic polarisation, by the method described in a previous communication. [See Abstract 2642 (1924).] In the case of kathodic polarisation the metals go into solution with the formation of salts before visible evolution of hydrogen takes place. In the case of nickel a film of hydroxide forms on the surface from which hydrogen is evolved; this contrasts with previous observations in the case of iron, chromium and mercury. The behaviour of nickel in various salt solutions is discussed; the chemical changes accompanying changes in direction in the current-voltage curves are described for nickel and aluminium.

The insolubility of aluminium with anodic polarisation is due to the formation of a film of oxide. As a result of the observations made it is concluded that the passive state of metals is determined entirely by the chemical conditions surrounding the kathode and is not due to any change in the metal itself, since by suitably controlling the conditions, the metal may assume either the active or the passive state. B. W. C.

**1272.** *Studies of Electrolytic Polarisation. Part II. Kathodic Overvoltage of Mercury.* **S. Glasstone.** (Chem. Soc., J. 125. pp. 2646–2656, Dec., 1924.)—The experiments are made as before [Abstract 462 (1925)] with mercury in sulphuric acid at 10° or 70° C. and platinum-wire leads. The back e.m.f. is measured by means of the commutator at 0·002, 0·004, 0·006, 0·012 sec. after the polarising current is switched off, the potential of the electrode at the moment of breaking the circuit being obtained by extrapolation; these results are compared with direct measurements. Against Newbury the author maintains that the back e.m.f. does not become constant at high commutator speeds and may be lower than the instantaneous back e.m.f. at the moment of switching off. At high-current densities and with increasing concentration the direct and extrapolated overvoltages (of the order of 1 volt) began to differ, particularly at low temperature, probably owing to a resistance at the electrode surface; the minimum overvoltage is constant and independent of the hydrogen-ion concentration even in alkaline solution. Like Dunnill [Abstract 1454 (1922)] the author observes that the mercury surface, or the electrolyte on it, seems to be pulled away from the kathode towards the walls of the vessel when the polarising current is switched off. This is connected with a diffusion of oxygen from the anode and is influenced by the surface condition of the glass wall, the catalytic effect being strong when the glass had been heated with alkali, and absent when it was coated with paraffin wax. H. B.

**1273.** *Electrolytic Oxidation of p-Nitrotoluene and p-Chlorotoluene to their Respective Acids.* **R. F. Dunbrook** and **A. Lowy.** (Am. Electrochem. Soc., Trans. 45. pp. 81–101; Disc., 101–105, 1924.)—The optimum conditions for these oxidations are given. T. H. P.

**1274.** *Electrolytic Preparation of Metanilic Acid and its Commercial Possibilities.* **A. K. Doolittle.** (Am. Electrochem. Soc., Trans. 45. pp. 57–75; Disc., 76–80, 1924.)—The preparation of metanilic acid by electrolytic reduction of the corresponding nitro-acid has been studied, but the results as yet obtained do not lead to a satisfactory commercial method. T. H. P.

**1275.** *The Electrolytic Production of Beryllium.* **B. S. Hopkins** and **A. W. Meyer.** (Am. Electrochem. Soc., Trans. 45. pp. 475–482; Disc., 490–491, 1924.)—Residues from Texan gadolinite are treated with hydrochloric acid and sodium bicarbonate to separate iron and aluminium from beryllium. Basic beryllium carbonate is prepared from which a double fluoride, essentially $NaBeF_3$, is obtained. The salt is fused and electrolysed, using carbon anodes, a nickel crucible as kathode, and a current of 6 amps. at 110 volts. Metallic beryllium is obtained as thin flakes scattered through the electrolyte and mixed with beryllium oxide and carbide. The metal is separated from everything except the oxide by sprinkling into water, and the oxide is removed by centrifuging. Metal of 98 % purity is obtained, but the yield is poor. J. N. P.

**1276.** *The Metallurgy and Alloys of Beryllium.* **E. A. Engle** and **B. S. Hopkins.** (Am. Electrochem. Soc., Trans. 45. pp. 483–490; Disc., 490–491, 1924.)—A critical study of the electrometallurgy of beryllium establishes the fact that beryllium oxide is soluble in various fused salts, from which solutions metallic beryllium may be deposited electrolytically. More efficient results are secured by the electrolysis of a fused bath of barium fluoride and sodium beryllium fluoride. These electrolytes combine such desired properties as density, relative inertness and suitable melting temperature. The use of a molten metal kathode yields directly the corresponding beryllium alloy in many cases. J. N. P.

**1277.** *Relation between Polarisation and Structure in the Electrodeposition of Metals.* **V. Kohlschutter.** (Am. Electrochem. Soc., Trans. 45. pp. 229–240; Disc., 240–247, 1924.)—Such previous investigations by the author and others [see Abstract 1328 (1924)], which bear upon polarisation and structure are summarised and a close relationship is shown to exist between the abnormal kathode potential in the deposition of Ni and certain physical properties of the deposit, including the smoothness of the plate, the hydrogen content of the plate, and its tendency to contract and peel. It is found that factors affecting any one of these abnormal properties will also affect the other two. Elimination of the film of H gives rise to a more coarsely crystalline deposit with little or no contraction, and abnormal polarisation is largely eliminated. Substitution of a film of $CO_2$ for that of H restores the mirror-like surface of the deposit and the tendency to contract, but not the abnormally high polarisation voltage. It is concluded that, under ordinary conditions, Ni is deposited in a viscous film of H and in a highly dispersed form.

In the *Discussion,* **F. Frölich** regards the explanation of the phenomena on the basis of surface conditions as in opposition to nearly all experimental facts obtained in studies of the different metal-hydrogen systems by other authors, and instances a number of metals able to take up H when deposited together with this element, or polarised kathodically in straight acid solutions. The exceptional catalytic activities of Ni are cited as rendering unjustifiable a generalisation of the hypothesis to cover other metals. **A. K. Graham** mentions the possibility of metallic allotropy entering into the observed effects. **H. E. Haring** thinks that the abnormally high polarisation at Ni electrodes is due to the formation of gas electrodes, and suggests the possibility of using the potentials of such electrodes as a measure of the H-ion concentration at the electrode-solution interface. A. B. C. L.

**1278.** *Electrodeposition of Manganese. Part II.* **A. J. Allmand** and **A. N. Campbell.** (Faraday Soc., Trans. 20. pp. 379–384, Dec., 1924.)—The previous researches [Abstract 2646 (1924)] left the question of optimum temperature and kathodic current density not quite decided. The authors now recommend electrolysis of ammonium and manganous sulphates as katholyte in a diaphragm cell containing ammonium sulphate as anolyte, the $H^{\cdot}$ concentration to be kept at $10^{-6}$ to $10^{-8}$ by addition of sulphuric acid or ammonia, at 30° and a current density of 10 to 15 amps./$dm.^2$. The rotating kathode of aluminium has a burnisher lightly pressing against it. H. B.